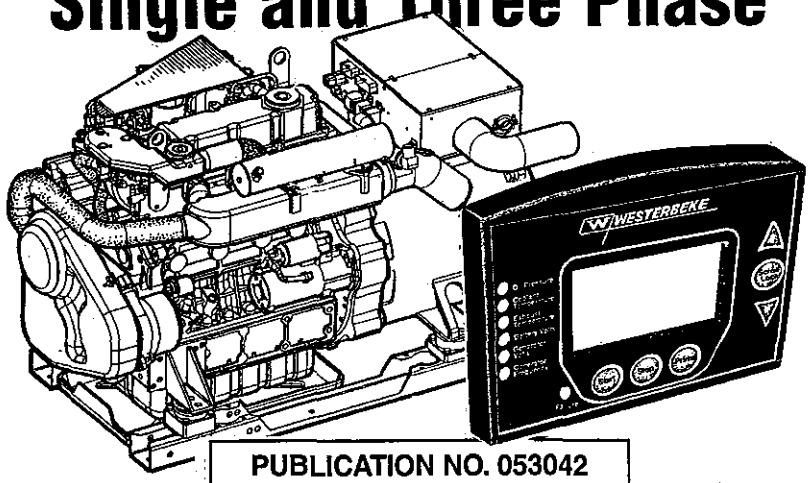
OPERATORS MANUAL
D-NET DIESEL GENERATORS

33KW EDE - 60Hz
28.5KW EDE - 60Hz
26KW EDE - 50Hz
23.5KW EDE - 50Hz
25.5KW EDE - 60Hz
21.0KW EDE - 50Hz
Single and Three Phase



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WESTERBEKE

WESTERBEKE CORPORATION • 150 JOHN HANCOCK ROAD
MYLES STANDISH INDUSTRIAL PARK • TAUNTON MA 02780
WEB SITE: WWW.WESTERBEKE.COM

NMMA Member National Marine Manufacturers Association

CALIFORNIA
PROPOSITION 65 WARNING

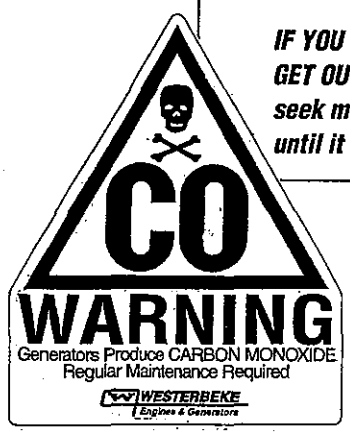
Marine diesel and gasoline engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

⚠ WARNING

Exhaust gasses contain Carbon Monoxide, an odorless and colorless gas. Carbon Monoxide is poisonous and can cause unconsciousness and death. Symptoms of Carbon Monoxide exposure can include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and Sleepiness***
- ***Throbbing in Temples***
- ***Muscular Twitching***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not restart until it has been inspected and repaired.



A WARNING DECAL is provided by WESTERBEKE and should be fixed to a bulkhead near your engine or generator.

WESTERBEKE also recommends installing CARBON MONOXIDE DETECTORS in the living/sleeping quarters of your vessel. They are inexpensive and easily obtainable at your local marine store.

WESTERBEKE
Engines & Generators

SAFETY INSTRUCTIONS

INTRODUCTION

Read this safety manual carefully. Most accidents are caused by failure to follow fundamental rules and precautions. Know when dangerous conditions exist and take the necessary precautions to protect yourself, your personnel, and your machinery.
The following safety instructions are in compliance with the American Boat and Yacht Council (ABYC) standards.

PREVENT ELECTRIC SHOCK

⚠ WARNING: ***Do not touch AC electrical connections while engine is running, or when connected to shore power. Lethal voltage is present at these connections!***

- Do not operate this machinery without electrical enclosures and covers in place.
- Shut off electrical power before accessing electrical equipment.
- Use insulated mats whenever working on electrical equipment.
- Make sure your clothing and skin are dry, not damp (particularly shoes) when handling electrical equipment.
- Remove wristwatch and all jewelry when working on electrical equipment.
- Do not connect utility shore power to vessels AC circuits, except through a ship-to-shore double throw transfer switch. Damage to vessels AC generator may result if this procedure is not followed.
- Electrical shock results from handling a charged capacitor. Discharge capacitor by shorting terminals together.

PREVENT BURNS — HOT ENGINE

⚠ WARNING: ***Do not touch hot engine parts or exhaust system components. A running engine gets very hot!***

- Always check the engine coolant level at the coolant recovery tank.

⚠ WARNING: ***Steam can cause injury or death!***

- In case of an engine overheat, allow the engine to cool before touching the engine or checking the coolant.

PREVENT BURNS — FIRE

⚠ WARNING: ***Fire can cause injury or death!***

- Prevent flash fires. Do not smoke or permit flames or sparks to occur near the carburetor, fuel line, filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Use a suitable container to catch all fuel when removing the fuel line, carburetor, or fuel filters.
- Do not operate without a Coast Guard Approved flame arrester. Backfire can cause severe injury or death.
- Do not operate with the air cleaner/silencer removed. Backfire can cause severe injury or death.
- Do not smoke or permit flames or sparks to occur near the fuel system. Keep the compartment and the engine/generator clean and free of debris to minimize the chances of fire. Wipe up all spilled fuel and engine oil.
- Be aware — diesel fuel will burn.

PREVENT BURNS — EXPLOSION

⚠ WARNING: ***Explosions from fuel vapors can cause injury or death!***

- Follow re-fueling safety instructions. Keep the vessels hatches closed when fueling. Open and ventilate cabin after fueling. Check below for fumes/vapor before running the blower. Run the blower for four minutes before starting your engine.
- All fuel vapors are highly explosive. Use extreme care when handling and storing fuels. Store fuel in a well-ventilated area away from spark-producing equipment and out of the reach of children.
- Do not fill the fuel tank(s) while the engine is running.
- Shut off the fuel service valve at the engine when servicing the fuel system. Take care in catching any fuel that might spill. DO NOT allow any smoking, open flames, or other sources of fire near the fuel system or engine when servicing. Ensure proper ventilation exists when servicing the fuel system.
- Do not alter or modify the fuel system.
- Be sure all fuel supplies have a positive shutoff valve.
- Be certain fuel line fittings are adequately tightened and free of leaks.
- Make sure a fire extinguisher is installed nearby and is properly maintained. Be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications encountered in this environment.

SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

⚠ WARNING: ***Accidental starting can cause injury or death!***

- Disconnect the battery cables before servicing the engine/generator. Remove the negative lead first and reconnect it last.
- Make certain all personnel are clear of the engine before starting.
- Make certain all covers, guards, and hatches are re-installed before starting the engine.

BATTERY EXPLOSION

⚠ WARNING: ***Battery explosion can cause injury or death!***

- Do not smoke or allow an open flame near the battery being serviced. Lead acid batteries emit hydrogen, a highly explosive gas, which can be ignited by electrical arcing or by lit tobacco products. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.
- Never connect the negative (–) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb the battery charger connections while the battery is being charged.
- Avoid contacting the terminals with tools, etc., to prevent burns or sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling the battery.
- Always turn the battery charger off before disconnecting the battery connections. Remove the negative lead first and reconnect it last when disconnecting the battery.

BATTERY ACID

⚠ WARNING: ***Sulfuric acid in batteries can cause severe injury or death!***

- When servicing the battery or checking the electrolyte level, wear rubber gloves, a rubber apron, and eye protection. Batteries contain sulfuric acid which is destructive. If it comes in contact with your skin, wash it off at once with water. Acid may splash on the skin or into the eyes inadvertently when removing electrolyte caps.

TOXIC EXHAUST GASES

⚠ WARNING: ***Carbon monoxide (CO) is a deadly gas!***

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifolds/water-injected elbow is securely attached.
- Be sure the unit and its surroundings are well ventilated. Run blowers when running the generator set or engine.
- Do not run the generator set or engine unless the boat is equipped with a functioning marine carbon monoxide detector that complies with ABYCA-24. Consult your boat builder or dealer for installation of approved detectors.
- For additional information refer to ABYC T-22 (educational information on Carbon Monoxide).

⚠ WARNING: ***Carbon monoxide (CO) is an invisible odorless gas. Inhalation produces flu-like symptoms, nausea or death!***

- Do not use copper tubing in diesel exhaust systems. Diesel fumes can rapidly destroy copper tubing in exhaust systems. Exhaust sulfur causes rapid deterioration of copper tubing resulting in exhaust/water leakage.
- Do not install exhaust outlet where exhaust can be drawn through portholes, vents, or air conditioners. If the engine exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or restrict the flow of exhaust. Avoid overloading the craft.
- Although diesel engine exhaust gases are not as toxic as exhaust fumes from gasoline engines, carbon monoxide gas is present in diesel exhaust fumes. Some of the symptoms or signs of carbon monoxide inhalation or poisoning are:

Vomiting	Inability to think coherently
Dizziness	Throbbing in temples
Headache	Muscular twitching
Nausea	Weakness and sleepiness

AVOID MOVING PARTS

⚠ WARNING: ***Rotating parts can cause injury or death!***

- Do not service the engine while it is running. If a situation arises in which it is absolutely necessary to make operating adjustments, use extreme care to avoid touching moving parts and hot exhaust system components.

- Do not wear loose clothing or jewelry when servicing equipment; tie back long hair and avoid wearing loose jackets, shirts, sleeves, rings, necklaces or bracelets that could be caught in moving parts.
- Make sure all attaching hardware is properly tightened. Keep protective shields and guards in their respective places at all times.
- Do not check fluid levels or the drive belts tension while the engine is operating.
- Stay clear of the drive shaft and the transmission coupling when the engine is running; hair and clothing can easily be caught in these rotating parts.

HAZARDOUS NOISE

⚠ WARNING: ***High noise levels can cause hearing loss!***

- Never operate an engine without its muffler installed.
- Do not run an engine with the air intake (silencer) removed.
- Do not run engines for long periods with their enclosures open.

⚠ WARNING: ***Do not work on machinery when you are mentally or physically incapacitated by fatigue!***

OPERATORS MANUAL

Many of the preceding safety tips and warnings are repeated in your Operators Manual along with other cautions and notes to highlight critical information. Read your manual carefully, maintain your equipment, and follow all safety procedures.

GASOLINE ENGINE AND GENERATOR INSTALLATIONS

Preparations to install an engine should begin with a thorough examination of the American Boat and Yacht Council's (ABYC) standards. These standards are a combination of sources including the USCG and the NFPA.

Sections of the ABYC standards of particular interest are:

H-2 Ventilation
P-1 Exhaust Systems
P-4 Inboard Engines
E-9 DC Electrical Systems

All installations must comply with the Federal Code of Regulations (FCR).

ABYC, NFPA AND USCG PUBLICATIONS FOR INSTALLING DIESEL ENGINES

Read the following ABYC, NFPA and USCG publications for safety codes and standards. Follow their recommendations when installing your engine.

ABYC (American Boat and Yacht Council)
"Safety Standards for Small Craft"

Order from:

ABYC
3069 Solomon's Island Rd.
Edgewater, MD 21037

NFPA (National Fire Protection Association)
"Fire Protection Standard for Motor Craft"

Order from:

NFPA
11 Tracy Drive
Avon Industrial Park
Avon, MA 02322

USCG (United States Coast Guard)
"USCG 33CFR183"

Order from:

U.S. Government Printing Office
Washington, D.C. 20404

INSTALLATION

When installing WESTERBEKE engines and generators it is important that strict attention be paid to the following information:

CODES AND REGULATIONS

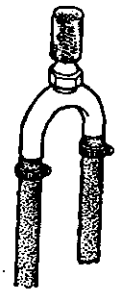
Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and generators in a marine environment.

SIPHON-BREAK

For installations where the exhaust manifold/water injected exhaust elbow is close to or will be below the vessel's waterline, provisions must be made to install a siphon-break in the raw water supply hose to the exhaust elbow. This hose must be looped a minimum of 20" above the vessel's waterline. ***Failure to use a siphon-break when the exhaust manifold injection port is at or below the load waterline will result in raw water damage to the engine and possible flooding of the boat.***

If you have any doubt about the position of the water-injected exhaust elbow relative to the vessel's waterline under the vessel's various operating conditions, ***install a siphon-break.***

NOTE: *A siphon-break requires periodic inspection and cleaning to ensure proper operation. Failure to properly maintain a siphon-break can result in catastrophic engine damage. Consult the siphon-break manufacturer for proper maintenance.*



AVAILABLE FROM YOUR WESTERBEKE DEALER

EXHAUST SYSTEM

The exhaust hose must be certified for marine use. The system must be designed to prevent water from entering the exhaust under any sea conditions and at any angle of the vessels hull.

A detailed 40 page Marine Installation Manual covering gasoline and diesel, engines and generators, is available from your WESTERBEKE dealer.

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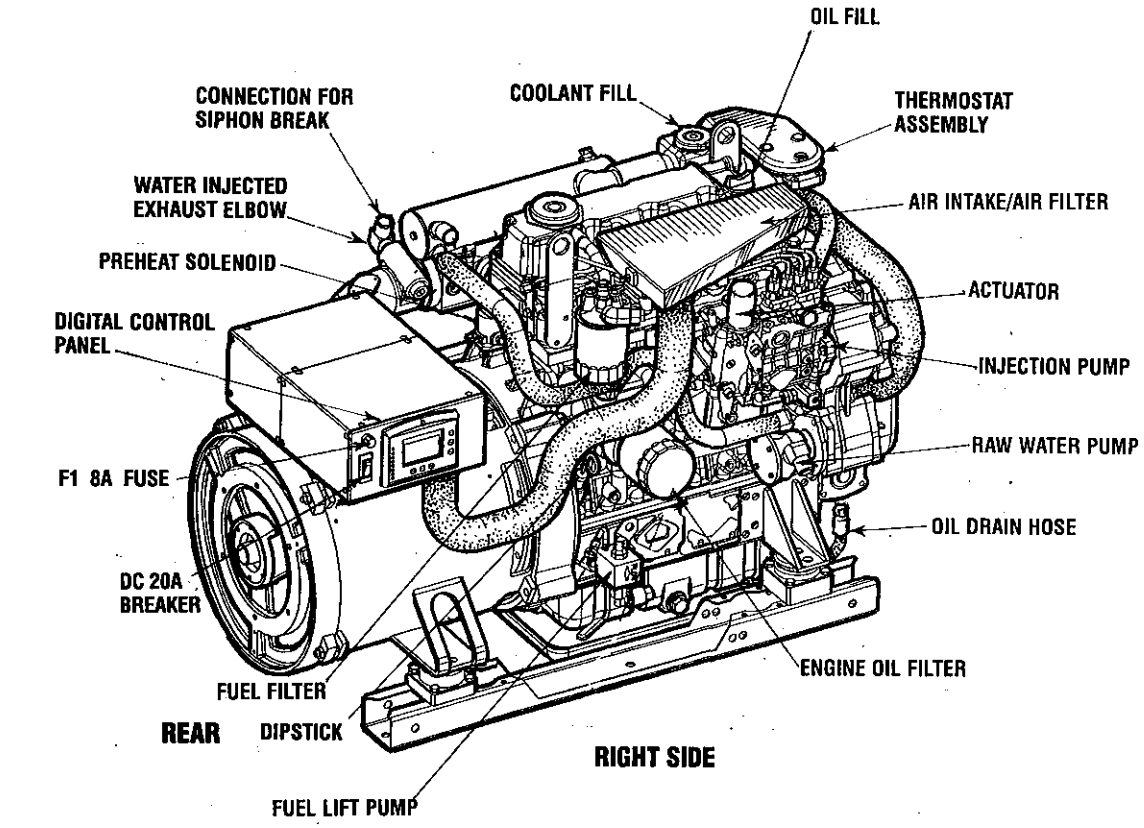
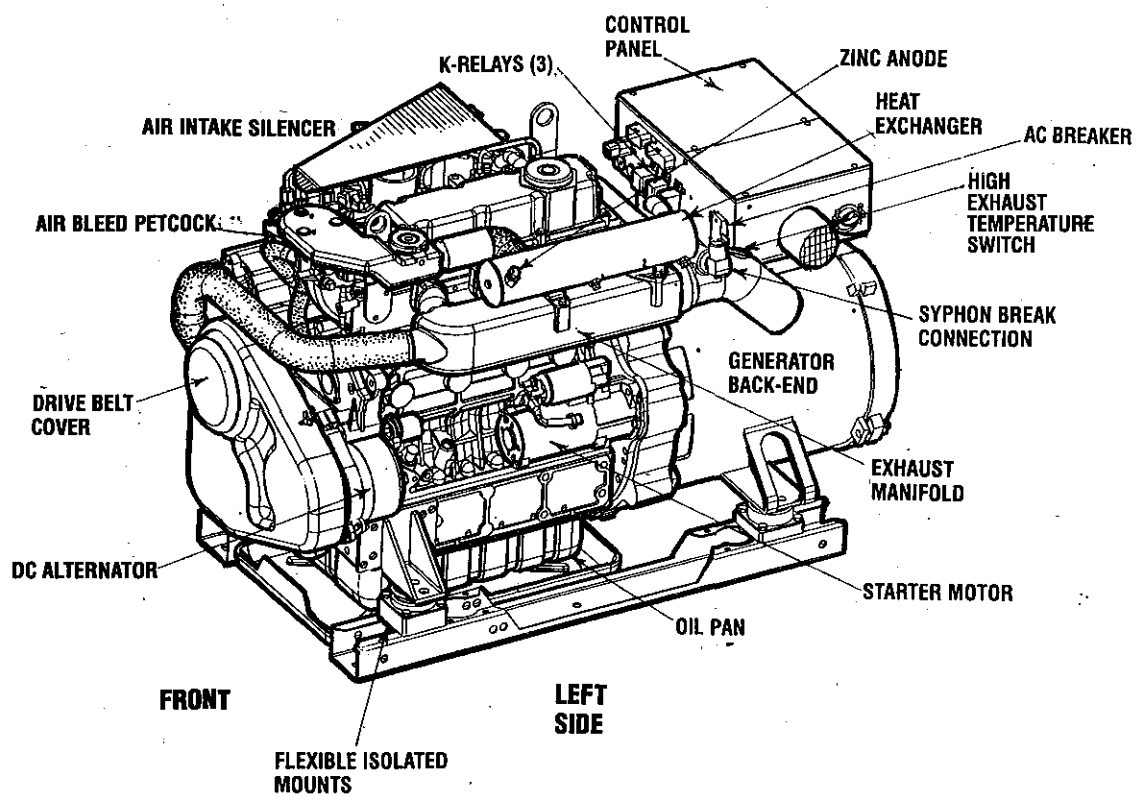
PARTS IDENTIFICATION





INTRODUCTION

This WESTERBEKE Diesel Generator is a product of WESTERBEKE's long years of experience and advanced technology. We take great pride in the superior durability and dependable performance of our engines and generators. Thank you for selecting WESTERBEKE.

In order to get the full use and benefit from your generator, it is important that you operate and maintain it correctly. This manual is designed to help you do this. Please read this manual carefully and observe all the safety precautions throughout. Should your engine require servicing, contact your nearest WESTERBEKE dealer for assistance.

This is your operators manual. A parts catalog is also provided and a technical manual is available from your WESTERBEKE dealer. If you are planning to install this equipment, contact your WESTERBEKE dealer for WESTERBEKE'S installation manual.

WARRANTY PROCEDURES

Your WESTERBEKE Warranty is included in a separate folder. If, after 60 days of submitting the Warranty Registry form you have not received a customer identification card registering your warranty, please contact the factory in writing with model information, including the unit's serial number and commission date.

Customer Identification Card

WESTERBEKE

Customer Identification
MR. GENERATOR OWNER
MAIN STREET
HOMETOWN, USA
Model Ser. #
Expires

NOTES, CAUTIONS AND WARNINGS

As this manual takes you through the operating procedures, maintenance schedules, and troubleshooting of your marine engine, critical information will be highlighted by NOTES, CAUTIONS, and WARNINGS. An explanation follows:

NOTE: *An operating procedure essential to note.*

⚠ CAUTION: ***Procedures which, if not strictly observed, can result in the damage or destruction of your engine.***

⚠ WARNING: ***Procedures which, if not properly followed, can result in personal injury or loss of life.***

PRODUCT SOFTWARE

Product software, (technical data, parts lists, manuals, brochures and catalogs), provided from sources other than WESTERBEKE are not within WESTERBEKE's control.

WESTERBEKE CANNOT BE RESPONSIBLE FOR THE CONTENT OF SUCH SOFTWARE, MAKES NO WARRANTIES OR REPRESENTATIONS WITH RESPECT THERETO, INCLUDING ACCURACY, TIMELINESS OR COMPLETENESS THEREOF AND WILL IN NO EVENT BE LIABLE FOR ANY TYPE OF DAMAGE OR INJURY INCURRED IN CONNECTION WITH OR ARISING OUT OF THE FURNISHING OR USE OF SUCH SOFTWARE.

WESTERBEKE customers should keep in mind the time span between printings of WESTERBEKE product software and the unavoidable existence of earlier WESTERBEKE product software. The product software provided with WESTERBEKE products, whether from WESTERBEKE or other suppliers, must not and cannot be relied upon exclusively as the definitive authority on the respective product. It not only makes good sense but is imperative that appropriate representatives of WESTERBEKE or the supplier in question be consulted to determine the accuracy and currentness of the product software being consulted by the customer.

PROTECTING YOUR INVESTMENT

Care at the factory during assembly and thorough testing have resulted in a WESTERBEKE generator capable of many thousands of hours of dependable service. However the manufacturer cannot control how or where the generator is installed in the vessel or the manner in which the unit is operated and serviced in the field. This is up to the buyer/owner-operator.

NOTE: *Six important steps to ensure long generator life:*

- ***Proper engine and generator installation and alignment.***
- ***An efficient well-designed exhaust system that includes an anti-siphon break to prevent water from entering the engine.***
- ***Changing the engine oil and oil filters according to the maintenance schedule.***
- ***Proper maintenance of all engine and generator components according to the maintenance schedule in this manual.***
- ***Use clean, filtered unleaded fuel.***
- ***Winterize your engine according to the "Lay-up and Recommissioning" section in this manual.***

INTRODUCTION

SERIAL NUMBER LOCATION

The engine's model number and serial number are located on a nameplate mounted on the side of the engine.
The engine's serial number can also be found stamped into the engine block on the flat surface of the block just above and inboard of the injection pump. Take the time to enter this information on the illustration of the nameplate shown below, as this will provide a quick reference when seeking technical information and/or ordering repair parts.

SPECIFICATION	50 HZ.	60 HZ.
MODEL		
RPM		
KW		
KVA		
VOLTS		
AMPS		
ENG. HP		
ENG. SER. NO.		
GEN. SER. NO.		
PF/PHASE	/	
WIRES		
RATING		
INSUL. CLASS		
TEMP. RISE		
BATTERY		
C.I.D.		

An identification plate on the top of the engine air intake also displays the engine model and serial number.

CARBON MONOXIDE DETECTOR

WESTERBEKE recommends mounting a carbon monoxide detector in the vessels living quarters. **Carbon monoxide, even in small amounts, is deadly.**

The presence of carbon monoxide indicates an exhaust leak from the engine or generator or from the exhaust elbow/exhaust hose, or the fumes from a nearby vessel are entering your boat.

If carbon monoxide is present, ventilate the area with clean air and correct the problem immediately!

NOTE: *A carbon monoxide warning decal has been provided by WESTERBEKE. Affix this decal in a visible position in the engine room.*

UNDERSTANDING THE DIESEL ENGINE

The diesel engine closely resembles the gasoline engine, since the mechanism is essentially the same. The cylinders are arranged above a closed crankcase; the crankshaft is of the same general type as that of a gasoline engine; and the diesel engine has the same types of valves, camshaft, pistons, connecting rods and lubricating system.

Therefore, to a great extent, a diesel engine requires the same preventive maintenance as a gasoline engine. The most important factors are proper ventilation and proper maintenance of the fuel, lubricating and cooling systems. Replacement of fuel and lubricating filter elements at the time periods specified is a must, and frequent checking for contamination (that is, water, sediment, etc.) in the fuel system is also essential. Another important factor is the use of the same brand of high detergent diesel lubrication oil designed specifically for diesel engines.

The diesel engine does differ from the gasoline engine, however, in its method of handling and firing of fuel. The carburetor and ignition systems are done away with and in their place is a single component – the fuel injection pump – which performs the function of both.

ORDERING PARTS

Whenever replacement/service parts are needed, always provide the generator model number, engine serial number, and generator serial number as they appear on the silver and black name plate located on the generator end. You must provide us with this information so we may properly identify your generator set. In addition, include a complete part description and part number for each part needed (see the separately furnished Parts List). Also insist upon WESTERBEKE packaged parts because *will fit* or generic parts are frequently not made to the same specifications as original equipment.

SPARES AND ACCESSORIES

Certain spares will be needed to support and maintain your WESTERBEKE generator. Your local WESTERBEKE dealer will assist you in preparing an inventory of spare parts. See the *SPARE PARTS* page in this manual. For Engine and Generator Accessories, see the *ACCESSORIES* brochure.

INSTALLATION MANUAL

Publication #43400 provides detailed information for installing generators.

DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

DIESEL FUEL

Use fuel that meets the requirements or specification of Class 2-D (ASTM), and has a cetane rating of #45 or better.

Care Of The Fuel Supply

Use only clean diesel fuel! The clearance of the components in your fuel injection pump is very critical; invisible dirt particles which might pass through the filter can damage these finely finished parts. It is important to buy clean fuel, and keep it clean. The best fuel can be rendered unsatisfactory by careless handling or improper storage facilities. To assure that the fuel going into the tank for your engine's daily use is clean and pure, the following practice is advisable:

Purchase a well-known brand of fuel. The use of additives to combat BACTERIAL growth in the fuel tank is recommended such as Bio-Bor and an additive such as *Diesel Kleen + Cetane Boost* to restore lubricity back into the fuel when an Ultra Low Sulfur diesel is being used.

Install and regularly service a good, visual-type fuel filter/water separator between the fuel tank and the engine. The Raycor 500 MA or 230 RMAM are good examples of such filters.

ENGINE OIL

Use a heavy duty diesel oil with an API classification of CF, CG-4, CH-4 or CI-4. Change the engine oil and filter after the initial 50 hours of break-in operation. Then follow the oil and filter change intervals as specified in the **MAINTENANCE SCHEDULE** in this manual.
The use of synthetic oil is permited **ONLY** after the initial break-in period of 50 hours of engine operation has been achieved.

> ⚠ **CAUTION:** ***Do not allow two or more brands of engine oil to mix. Each brand contains its own additives; additives of different brands could react in the mixture to produce properties harmful to your engine.***

SAE Oil Viscosity Grades

For all temperature ranges:

SAE 10W-30 or SAE 15W-40

ENGINE COOLANT

WESTERBEKE recommends a mixture of 50% antifreeze and 50% distilled water. Distilled water is free from the chemicals that can corrode internal engine surfaces.

The antifreeze performs double duty. It allows the engine to run at proper temperatures by transferring heat away from the engine to the coolant, and lubricates and protects the cooling circuit from rust and corrosion. Look for a good quality antifreeze that contains Supplemental Cooling Additives (SCAs) that keep the antifreeze chemically balanced, crucial to long term protection.

The distilled water and antifreeze should be premixed before being poured into the cooling circuit.

NOTE: *Look for the new environmentally-friendly long lasting antifreeze that is now available.*

PURCHASING ANTIFREEZE

Rather than preparing the mixture, WESTERBEKE recommends buying the premixed antifreeze so that so that when adding coolant the mixture will always be correct. There are two common types of antifreeze, Ethylene Glycol (green) and Propylene Glycol (red/purple), either can be used but do not mix the two and if changing from one to another, flush the engine thoroughly.

Premixed antifreeze for DIESEL Engines: Specification #ASTM D53456.

MAINTENANCE

Change the engine coolant every five years regardless of the number of operating hours as the chemical additives that protect and lubricate the engine have a limited life.

COOLANT RECOVERY TANK

The coolant recovery tank allows for the expansion and contraction of the engines coolant during engine operation without introducing air into the system. This recovery tank is provided with fresh water cooled models and with the fresh water coolant conversion kit and must be installed before operating the engine.

PREPARATIONS FOR INITIAL START-UP

PRESTART INSPECTION

Before starting your generator for the first time or after a prolonged layoff, check the following items:

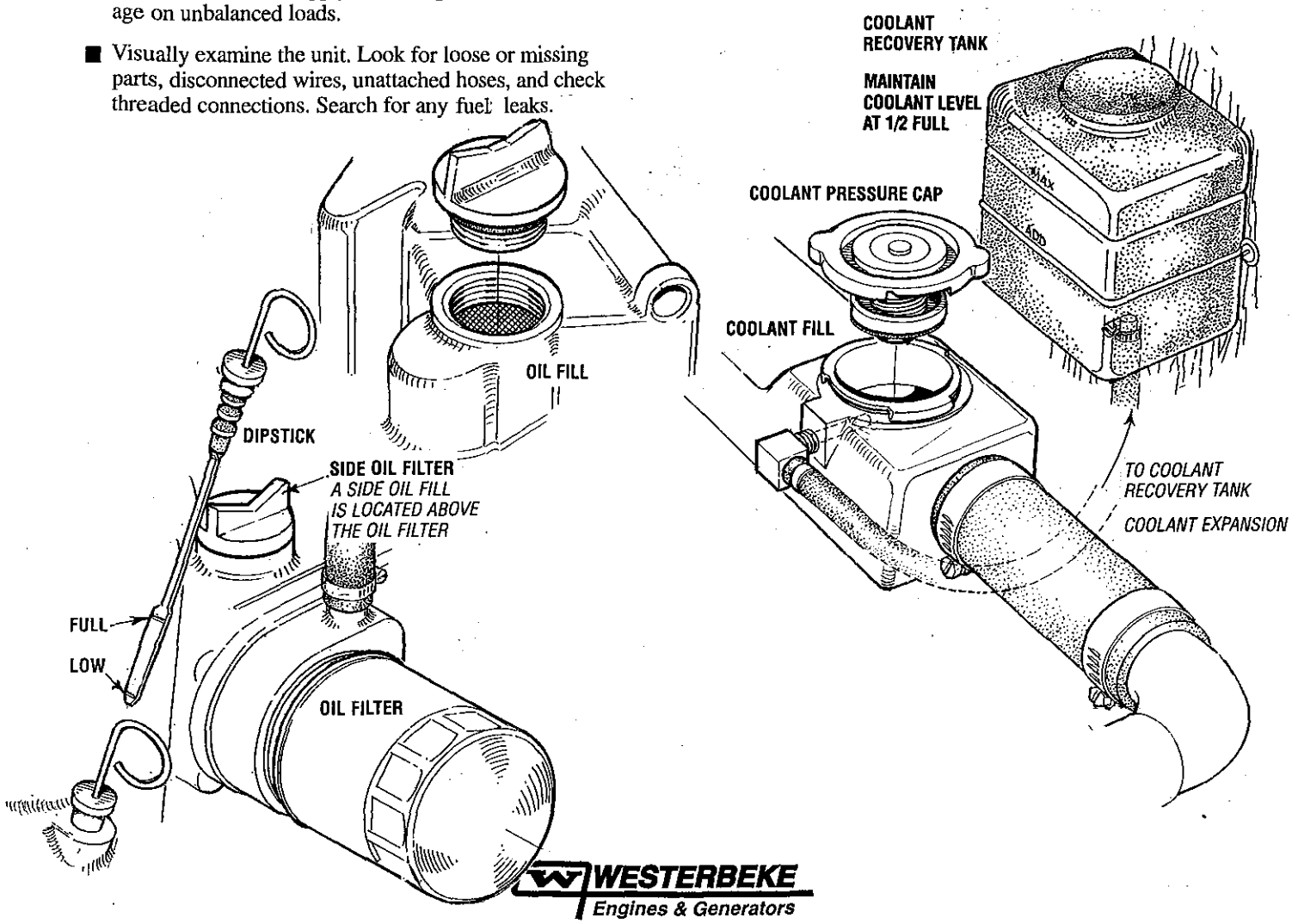
- Make certain the cooling water thru-hull petcock is open.
- Check the engine oil level: add oil to maintain the level at the full mark on the dipstick.
- Check the fuel supply and examine the fuel filter/separator bowls for contaminants.
- Check the DC electrical system. Inspect wire connections and battery cable connections.
- Check load leads for correct connections as specified in the wiring diagrams.
- Examine the air inlet and outlet for air flow obstructions (Soundguard).
- Be sure no other generator or utility power is connected to the load lines.
- Be sure that in power systems with a neutral line that the neutral is properly grounded (or ungrounded) as the system requires, and that generator neutral is properly connected to the load neutral. In single phase systems an incomplete or open neutral can supply the wrong line-to-neutral voltage on unbalanced loads.
- Visually examine the unit. Look for loose or missing parts, disconnected wires, unattached hoses, and check threaded connections. Search for any fuel leaks.

⚠ CAUTION: ***When starting the generator, it is recommended that all AC loads, especially large motors, be switched OFF until the engine has come up to speed and, in cold climates, starts to warm up. This precaution will prevent damage caused by unanticipated operation of the AC machinery and will prevent a cold engine from stalling.***

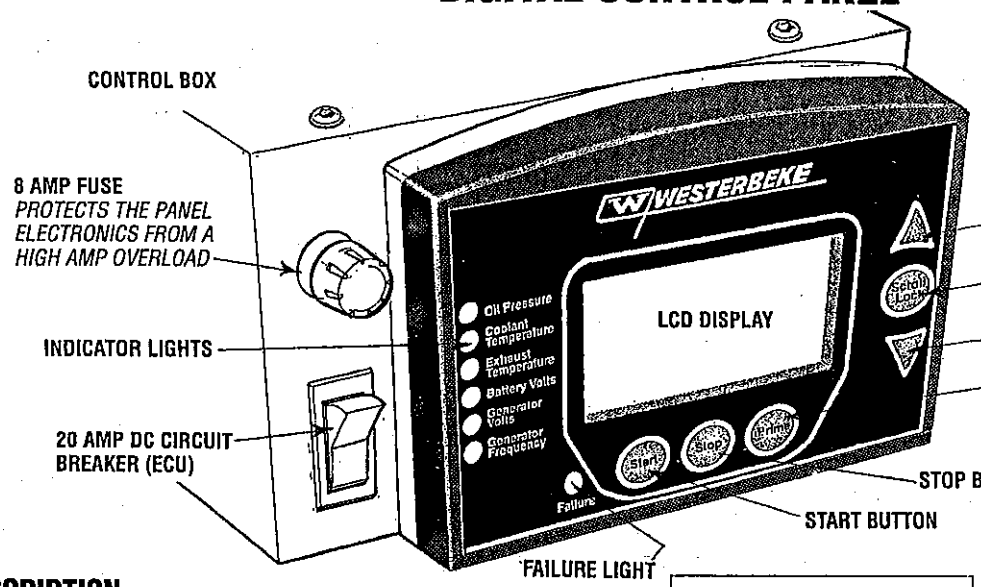
- Check the coolant level in both the plastic recovery tank and at the manifold.

NOTE: *After the initial running of the generator, the air in the engine's cooling system will be purged to the coolant recovery tank. Open the air bleed petcock to ensure that the cooling system is purged of air. After shutdown and after the engine has cooled, the coolant from the recovery tank will be drawn into the engine's cooling system to replace the purged air.*

Before subsequent operation of the generator, the engine's manifold should be topped off, and the coolant recovery tank may need to be filled to the MAX level.



DIGITAL CONTROL PANEL



NOTE: *During operation the color of the LCD display may vary. Caused by heat, this is normal and no cause for concern.*

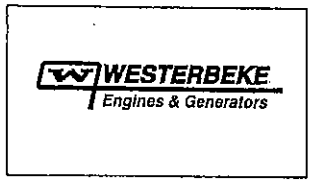
DESCRIPTION

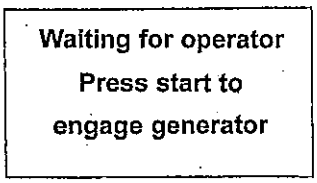
WESTERBEKE'S Digital Control Panel provides the operator with an LCD display that continuously monitors all the operations of the generator in easy to understand text messages.

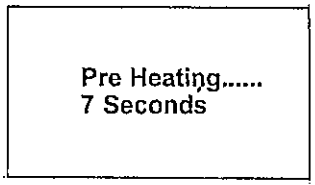
NOTE: *Operating temperatures may cause the LCD display to vary in color. This is normal and a change in color will not affect the operation of the control panel.*

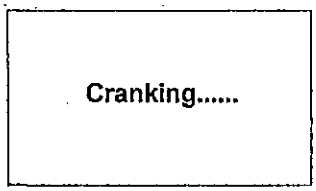
START SEQUENCE

With the pre-start inspection completed, press the START button and the automatic sequence will begin. The six indicator lights will illuminate green and the panel will display the following text:



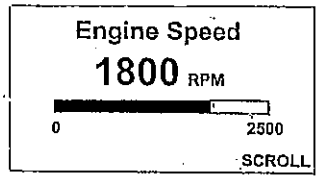


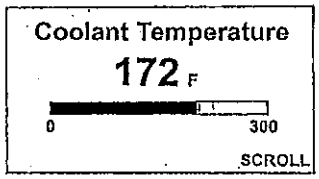


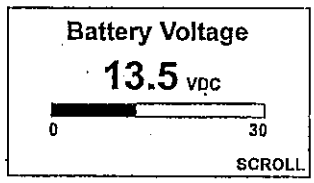


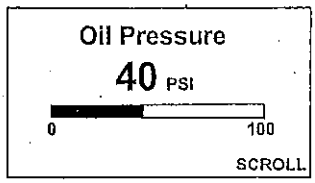
RUN SEQUENCE

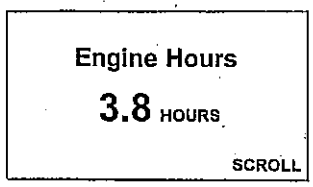
As the display cycles thru the engine functions, the speed will come up to 1800 rpm's-60Hz (1500rmp's-50Hz) and oil pressure and engine coolant will rise to their normal readings. The functions will cycle in the following sequence:

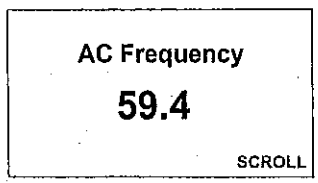


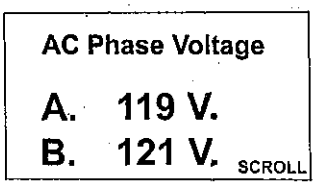


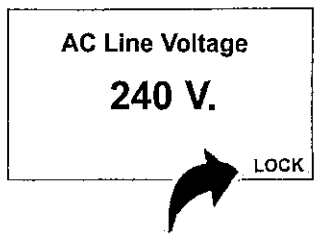












SCROLL LOCK

To stop the continuing sequence, press the SCROLL LOCK button. This enables the operator to monitor a single function for any length of time. The word LOCK will appear in the corner. Use the *up* and *down* arrows to find and observe other functions. To resume scrolling, press the SCROLL LOCK button again.

Up and Down Arrows

When the display is in its cycling mode, the UP and Down arrows can be used to adjust the dark and light contrast of the screen.

FUEL PRIMING

Use the PRIME button on the digital control panel to purge air and bring fuel back into the fuel lines after performing fuel filter maintenance.

LCD DISPLAY

Periodically clean the control panel and its LCD screen using a soft cloth.

DIGITAL CONTROL PANEL

STOP SEQUENCE

To stop the generator, press the STOP button. The display will cycle thru the following text messages and shutdown.

Shutting Down	Waiting for operator Press start to engage generator

Engine Shutdown

THE CONTROL PANEL WILL POWER-DOWN AND IN A FEW MOMENTS THE DISPLAY WILL GO BLANK

FAILURE LIGHT/SHUTDOWN

If a problem occurs, the generator will shutdown and the FAILURE light will illuminate red. In addition, one of the indicator lights will change from green to orange to reveal where the trouble has occurred and the display will text message what has happened.

CAUTION: When servicing/changing DC components. The DC power **must be turned off** using either the DC breaker or the battery switch.

Examples:

*Failure Light is **red**.*

*Coolant Temperature Light is **orange**.*

High Engine Temp.

Reset ECU to ReStart

*Failure Light is **red**.*

*Oil Pressure Light is **orange**.*

Low Oil Pressure

Reset ECU to Restart

When a failure occurs, refer to the troubleshooting chart, wiring diagram, and general operating text in this manual to assist in solving the trouble.

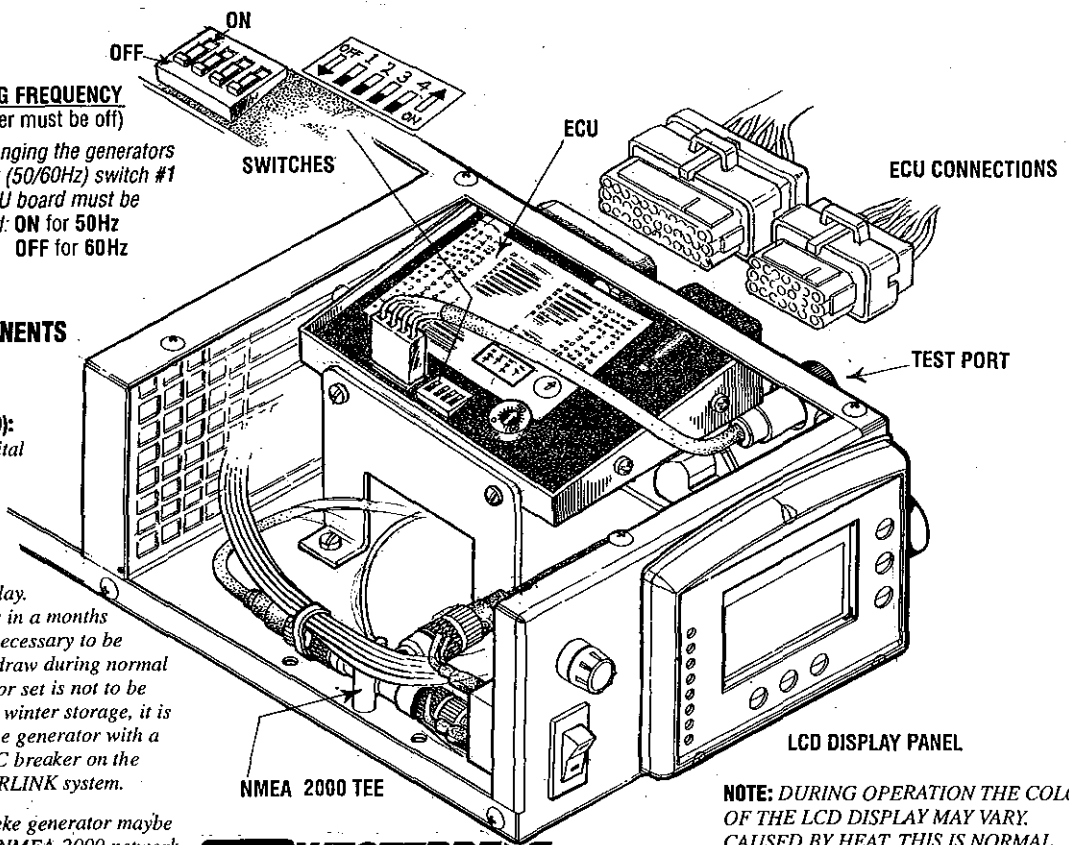
There are many combinations of messages that can be displayed but they are all self explanatory and the operator can easily isolate and correct the problem should one occur.

Before restarting the generator, the 20 amp DC circuit breaker ***must*** be pushed to the OFF position, and back to the ON position to reset the ECU. Once the problem is corrected and the generator is restarted, the LCD display will begin cycling again.

CHANGING FREQUENCY
(DC breaker must be off)

When changing the generators frequency (50/60Hz) switch #1 on the ECU board must be positioned: **ON** for **50Hz**
OFF for **60Hz**

CONTROL BOX INTERNAL COMPONENTS



CAUTION (WESTERLINK or NMEA-2000):
The electronic components in the Digital Diesels draw a very small amount of amperage (milli-amps) from the generator's starting battery when the unit is in a static state. This maybe as much as 50 milli-amps for the system ECU and 50 milli-amps for each display. This can be as much as 72 amp-hours in a months time with no generator use. It is not necessary to be concerned with this slight amperage draw during normal seasonal use. However, if the generator set is not to be used for a number of months, such as winter storage, it is best to disconnect the DC power to the generator with a NMEA-2000 system or shut off the DC breaker on the generator's control box for a WESTERLINK system.

NOTE: *Keep in mind that the Westerbeke generator maybe the DC power supply for the vessel's NMEA-2000 network.*

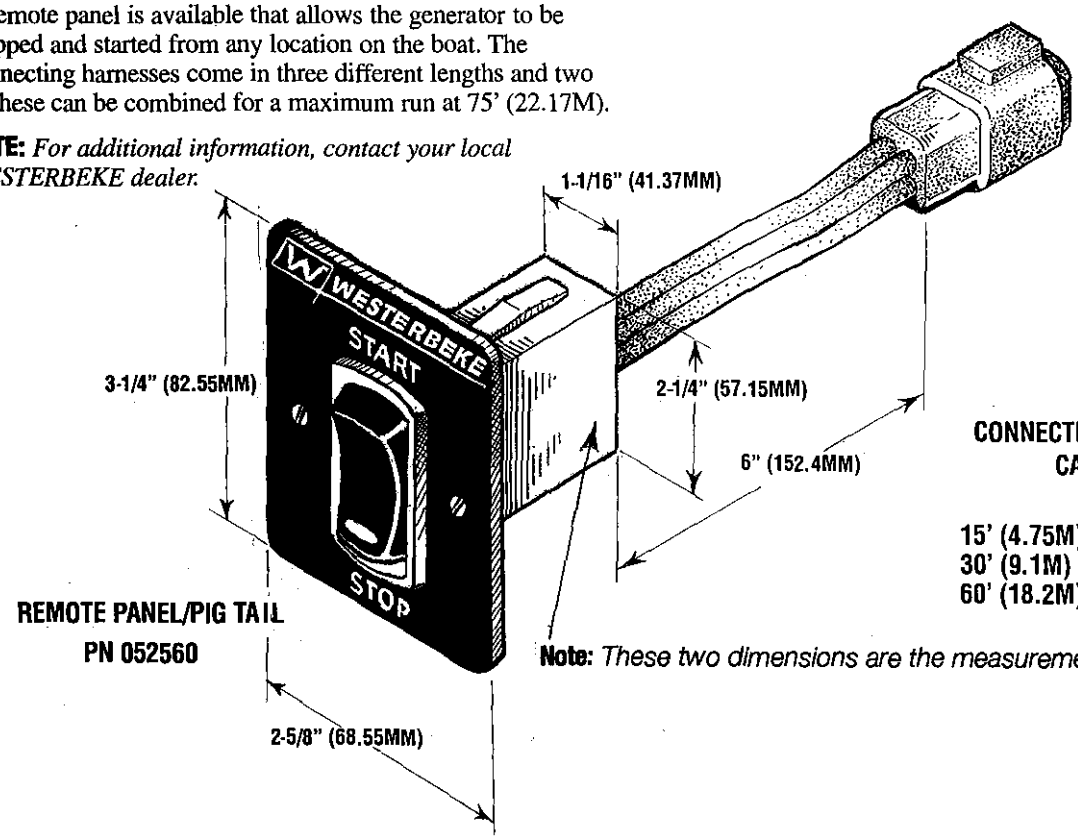
NOTE: *DURING OPERATION THE COLOR OF THE LCD DISPLAY MAY VARY. CAUSED BY HEAT, THIS IS NORMAL AND NO CAUSE FOR CONCERN.*

REMOTE STOP/START PANEL
AND EXTENSION HARNESSES

DESCRIPTION

A remote panel is available that allows the generator to be stopped and started from any location on the boat. The connecting harnesses come in three different lengths and two of these can be combined for a maximum run at 75' (22.17M).

NOTE: *For additional information, contact your local WESTERBEKE dealer.*



REMOTE PANEL/PIG TAIL
PN 052560

CONNECTING EXTENSION CABLES

15' (4.75M)	PN 052959
30' (9.1M)	PN 052789
60' (18.2M)	PN 052960

Note: *These two dimensions are the measurement of the cut-out opening.*

GENERATOR BREAK-IN PROCEDURE

DESCRIPTION

Although your engine has experienced a minimum of one hour of test operations at the factory to make sure accurate assembly procedures were followed and that the engine operated properly, a break-in time is required. The service life of your engine is dependent upon how the engine is operated and serviced during its initial hours of use.

Breaking-in a new engine basically involves seating the piston rings to the cylinder walls. Excessive oil consumption and smoky operation indicate that the cylinder walls are glazed or scored, which is caused by overloading the engine during the break-in period.

Your new engine requires approximately 50 hours of initial conditioning operation to break in each moving part in order to maximize the performance and service life of the engine. Perform this conditioning carefully, keeping in mind the following:

Start the engine according to the *STARTING PROCEDURE* section. Run the engine while checking that all systems (raw water pump, oil pressure, battery charging) are functioning.

AFTER START-UP

Once the generator has been started, check for proper operation and then encourage a fast warm-up. Run the generator between 20% and 60% of full-load for the first 10 hours.

After the first 10 hours of the generator's operation, the load can be increased to the full-load rated output, then periodically vary the load.

Avoid overload at all times. An overload is signaled by smoky exhaust with reduced output voltage and frequency. Monitor the current being drawn from the generator and keep it within the generator's rating. Since the generator operates at 1800 rpm to produce 60 hertz (or at 1500 rpm to produce 50 Hertz), control of the generator's break-in is governed by the current drawn from the generator.

NOTE: *Be aware of motor starting loads and the high current draw required for starting motors. This starting amperage draw can be 3 to 5 times normal running amperage. See* GENERATOR INFORMATION *in this manual.*

GENERATOR ADJUSTMENTS

Once the generator has been placed in operation, there may be governor adjustments required for engine speed (hertz) during the engine's break-in period (first 50 hours) or after this period see *ENGINE SPEED (HERTZ) ADJUSTMENT)* under *ENGINE ADJUSTMENTS.*. A no-load voltage adjustment may also be required in conjunction with the engine's speed adjustment see *GENERATOR INFORMATION.*

THE DAILY ROUTINE

CHECK LIST

Follow this check list each day before starting your generator.

- Check that all generator circuit breakers (power panel) are in the off position before starting.
- Record the hourmeter reading in your log (engine hours relate to the maintenance schedule.)

  Any deficiency or problems in the following items must be corrected before start up.
- Visually inspect the engine for fuel, oil, or water leaks.
- Check the oil level (dipstick).
- Check the coolant level in the coolant recovery tank.
- Check your fuel supply.
- Check the starting batteries (weekly).
- Check drive belts for wear and proper tension (weekly).

CHECK WITH THE ENGINE RUNNING.

- Check for abnormal noise such as knocking, vibrating and blow-back sounds.
- Confirm exhaust smoke:
  When the engine is cold - White Smoke.
  When the engine is warm - almost Smokeless.
  When the engine is overloaded - some Black Smoke.

NOTE: *Some unstable running may occur in a cold engine. This condition should abate as normal operating temperature is reached and loads are applied.*

> ⚠ **CAUTION:** ***Do not operate the generator for long periods of time without a load being placed on the generator.***

STOPPING THE GENERATOR

Remove the AC loads from the generator one at a time.Allow the generator to run for 3-5 minutes to stabilize the operating temperature, then momentarily depress the stop button and release. The generator will automatically shut down. Turn off the DC circuit breaker to prevent unintentional starts as a safety precaution.

MAINTENANCE SCHEDULE

> ⚠ **WARNING:** ***Never attempt to perform any service while the engine is running. Wear the proper safety equipment such as goggles and gloves, and use the correct tools for each job. Disconnect the battery terminals when servicing any of the engine's DC electrical equipment.***

NOTE: *Many of the following maintenance jobs are simple but others are more difficult and may require the expert knowledge of a service mechanic.*

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							EXPLANATION OF SCHEDULED MAINTENANCE
		50	100	250	500	750	1000	1250	
Fuel Supply	☐								Diesel No. 2 rating of 45 cetane or higher.
Fuel/Water Separator	☐								Check for water and dirt in fuel (drain/replace filter if necessary).
Engine Oil Level	☐								Oil level should indicate between MAX. and LOW on dipstick.
Coolant Level	☐								Check at recovery tank; if empty, check at manifold. Add coolant if needed.
Drive Belts	☐ weekly								Inspect for proper tension (3/8" to 1/2" depression) and adjust if needed. Check belt edges for wear.
Visual Inspection of Engine	☐	**NOTE:** *Please keep engine surface clean. Dirt and oil will inhibit the engine's ability to remain cool.*							Check for fuel, oil and water leaks. Inspect wiring and electrical connections. Keep bolts & nuts tight. Check for loose belt tension.
Fuel Filter		☐		☐	☐	☐	☐	☐	Initial change at 50 hrs, then change every 250 hrs.
Inlet Fuel Filter				☐	☐	☐	☐	☐	Replace.
Starting Batteries (and House Batteries)	☐ weekly								Every 50 operating hours check electrolyte levels and make sure connections are very tight. Clean off excessive corrosion.
Engine Oil (and filter)		☐		☐	☐	☐	☐	☐	Initial engine oil & filter change at 50 hrs., then change both every **250** hours.
Generator		☐	☐	☐	☐	☐	☐	☐	Check that AC connections are clean and secure with no chafing. See *GENERATOR MAINTENANCE* for additional information.
Heat Exchanger Zinc Anode		☐	☐	☐	☐	☐	☐	☐	Inspect zinc anode, replace if needed, clear the heat exchanger end of zinc anode debris.
Filter/Water Separator			☐	☐	☐	☐	☐	☐	Change the filter and/or drain water every 200 hrs.
Exhaust System		☐		☐		☐		☐	Initial check at 50 hrs., then every 250 hrs. Inspect for leaks. Check anti-siphon valve operation. Check the exhaust elbow for carbon and/or corrosion buildup on inside passages; clean and replace as necessary. Check that all connections are tight.
Engine Hoses			☐	☐	☐	☐	☐	☐	Hose should be hard & tight. Replace if soft or spongy. Check and tighten all hose clamps.

> ⚠ **CAUTION:** ***When servicing/changing DC components, the DC power must be turned off using either the DC breaker or the battery switch.***

MAINTENANCE SCHEDULE

NOTE: *Use the engine hour meter gauge to log your engine hours or record your engine hours by running time.*

SCHEDULED MAINTENANCE	CHECK EACH DAY	HOURS OF OPERATION							EXPLANATION OF SCHEDULED MAINTENANCE
		50	100	250	500	750	1000	1250	
Raw Water Pump *At 800 operating hours, disassemble and inspect for overhaul.*				☐		☐		☐	Remove the pump cover and inspect impeller, gasket, cam and cover for wear. Check the bearings and seals (the shaft should not wobble). Lubricate when reassembling.
Coolant System					☐		☐		Drain, flush, and refill cooling system with the appropriate antifreeze mix.
Electric Fuel Lift Pump		☐		☐	☐	☐	☐	☐	Periodically check the wiring connections and inspect the fuel line connections.
***Fuel Injectors**						☐			Check and adjust injection opening pressure and spray condition (see *ENGINE ADJUSTMENTS*).
***Starter Motor**					☐			☐	Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubricate the starter motor pinion drive.
***Preheat Circuit**					☐			☐	Check operation of preheat solenoid. Remove and clean glow plugs; check resistance (4-6 ohms). Reinstall with anti-seize compound on threads.
***Engine Cylinder Compression**					☐			☐	Check compression pressure and timing (see *Engine Adjustments*).
***Adjust the Valve Clearances**							☐		Adjust Valve Clearances (see *ENGINE ADJUSTMENTS*).
***Heat Exchanger**							☐		Remove, have professionally cleaned and pressure tested.
***Water Injected Exhaust Elbow**					☐		☐		Check casting integrity every 500 hours of operation. Replace as needed.

*WESTERBEKE recommends this service be performed by an authorized mechanic.

CAUTION (WESTERLINK or NMEA-2000): *The electronic components in the Digital Diesels draw a very small amount of amperage (milli-amps) from the generator's starting battery when the unit is in a static state. This maybe as much as 50 milli-amps for the system ECU and 50 milli-amps for each display. This can be as much as 72 amp-hours in a months time with no generator use. It is not necessary to be concerned with this slight amperage draw during normal seasonal use. However, if the generator set is not to be used for a number of months, such as winter storage, it is best to disconnect the DC power to the generator with a NMEA-2000 system or shut off the DC breaker on the generator's control box for a WESTERLINK system.*

NOTE: *Keep in mind that the Westerbeke generator maybe the DC power supply for the vessel's NMEA-2000 network.*

⚠ CAUTION: ***When servicing/changing DC components, the DC power must be turned off using either the DC breaker or the battery switch.***

FUEL SYSTEM

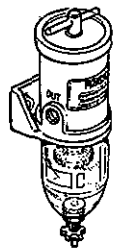
DIESEL FUEL

Use No.2 diesel fuel with a Cetane rating of 45 or higher. In conjunction with Ultra Low Sulphur Diesel. Use an additive such as "Diesel Kleen" produced by Power Services PS to help restore fuel lubrication (product #3025).

FUEL WATER SEPARATOR

A primary fuel filter of the water separating type must be installed between the fuel tank and the engine to remove water and other contaminants from the fuel before they can be carried to the fuel system on the engine.

A typical fuel filter/water separator is illustrated in this diagram. This is the Raycor Model 500 MA. Keep in mind that if a water separator type filter is not installed between the fuel supply tank and engine-mounted fuel system, any water in the fuel will affect the fuel pump, engine filter, and injection equipment. The owner/operator is responsible for making certain the fuel reaching the engine's injection equipment is free of impurities. This process is accomplished by installing and maintaining a proper filtration/separation system.



TYPICAL FUEL FILTER/WATER SEPARATOR

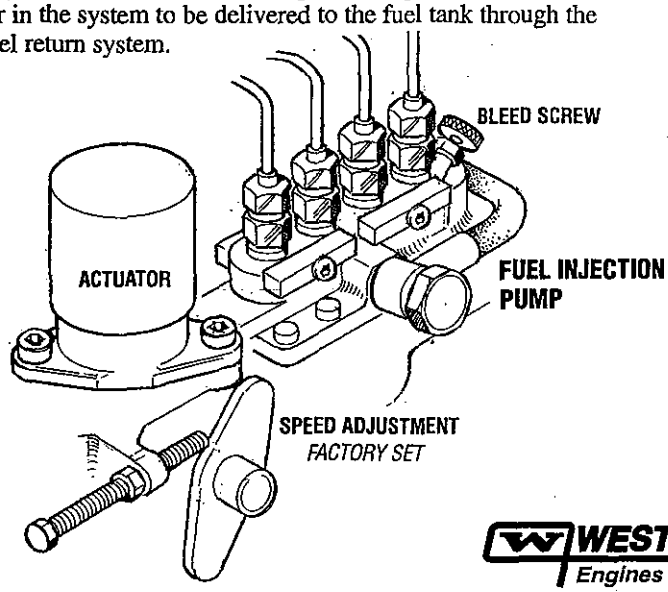
10 micron filter element recommended.

FUEL INJECTION PUMP

The fuel injection pump is the most important component of the diesel engine, requiring the utmost caution in handling. The fuel injection pump has been thoroughly bench-tested and the owner-operator is cautioned not to attempt to service it. If it requires servicing, remove it and take it to an authorized fuel injection pump service facility. Do not attempt to disassemble and repair it. Do not send the timing shims with the injection pump, leave on engine.

BLEED SCREW

The bleed screw on the injection pump should be left in the open position. This will then allow for ease in priming the engine's fuel system and during engine operation allow for air in the system to be delivered to the fuel tank through the fuel return system.



ENGINE FUEL FILTER

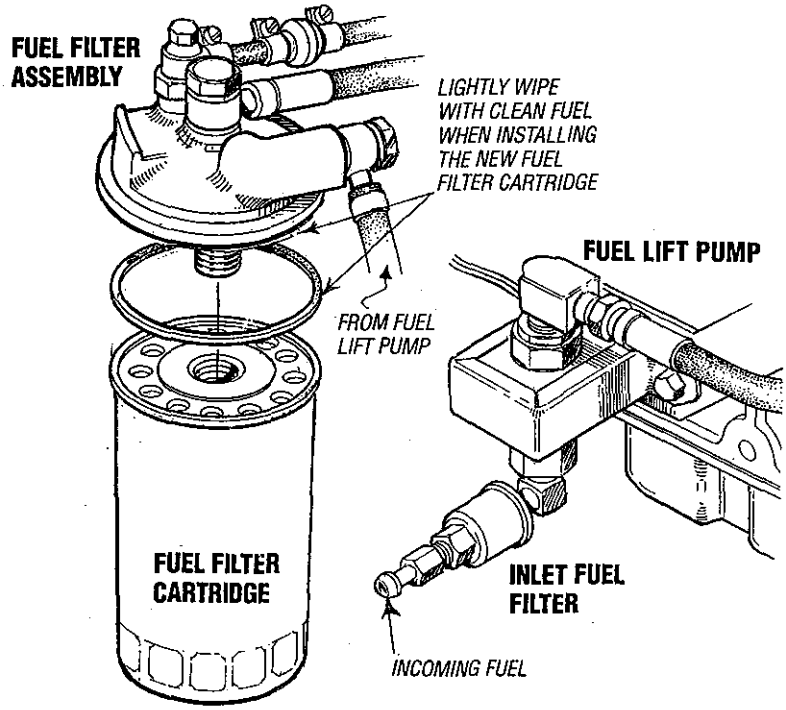
Periodically check the fuel connections and the filter bowl for leakage. Change the filter element after the first 50 hours. See the *MAINTENANCE SCHEDULE.*

Changing the Filter Cartridge

1. Shut off the fuel supply.

   NOTE: *Slide a plastic bag up over the fuel filter cartridge as it will be full of fuel.*

2. Unscrew the cartridge from its housing and remove the cartridge and its gasket.
3. Wipe both the housing and the top of the new cartridge with clean fuel.
4. To help reduce fuel system priming, fill the fuel filter with diesel before installing. This will dramatically reduce the priming time needed to purge air from the engines fuel system before starting.
5. Install the new cartridge and spin on real tight by hand.
6. Open the fuel supply. Run the engine to inspect for leaks.


FUEL FILTER ASSEMBLY
LIGHTLY WIPE WITH CLEAN FUEL WHEN INSTALLING THE NEW FUEL FILTER CARTRIDGE
FUEL LIFT PUMP
FROM FUEL LIFT PUMP
FUEL FILTER CARTRIDGE
INLET FUEL FILTER
INCOMING FUEL

FUEL LIFT PUMP

Periodically check the fuel connections to and out of the pump and make sure that no leakage is present and that the fittings are tight and secure. The DC ground connection at one of the pumps mounting bolts should be clean and well secured by the mounting bolts to ensure proper pump operations.

INLET FUEL FILTER

To ensure clean fuel into the fuel lift pump, there is a small in-line fuel filter connected to the fuel lift pump elbow. This filter should be replaced every 250 hours of operation.

COOLING SYSTEM

DESCRIPTION

Westerbeke marine diesel engines are designed and equipped for fresh water cooling. Heat produced in the engine by combustion and friction is transferred to fresh water coolant which circulates throughout the engine. This circulating fresh water coolant cools the engine block, its internal moving parts, and the engine oil. The heat is transferred externally from the fresh water coolant to raw water by means of a heat exchanger, similar in function to an automotive radiator. Raw water flows through the tubes of the heat exchanger while fresh water coolant flows around the tubes; engine heat transferred to the fresh water coolant is conducted through the tube walls to the raw water which is then pumped into the exhaust system where finally it is discharged overboard. In other words, the engine is cooled by fresh water coolant, this coolant is cooled by raw water, and the raw water carries the transferred heat overboard through the exhaust system. The fresh water coolant and raw water circuits are independent of each other. Using only fresh water coolant within the engine allows the cooling water passages to stay clean and free from harmful deposits.

RAW WATER INTAKE STRAINER

A major part of the raw water cooling system is a proper boatyard/builder installed intake strainer.

NOTE: *Always install the strainer at or below the waterline so the strainer will always be self-priming.*

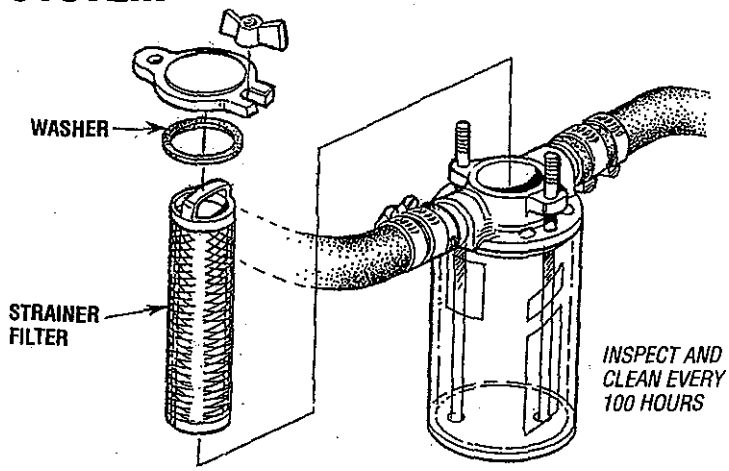
A clean raw water intake strainer is a vital component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the glass should be clear.

Perform the following maintenance after every 100 hours of operation:

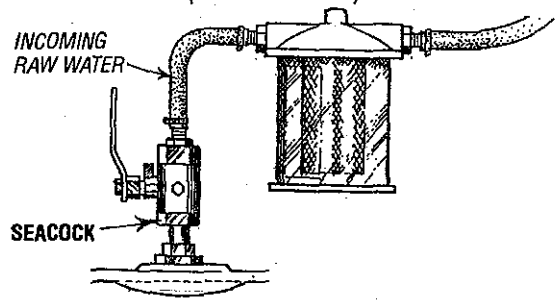
1. **Close the raw water seacock.**
2. Remove and clean the strainer filter.
3. Clean the glass.
4. Replace the washer if necessary.
5. Reassemble and install the strainer.
6. **Open the seacock.**
7. Run the engine and check for leaks.

NOTE: *Also follow the above procedure after having run hard aground.*

If the engine temperature gauge ever shows a higher than normal reading, the cause may be that silt, leaves or grass may have been caught up in the strainer, slowing the flow of raw water through the cooling system.



TYPICAL RAW WATER INTAKE STRAINER
(Owner Installed)



DRAINING THE RAW WATER SYSTEM

When freezing temperatures are expected, it is best to protect the raw water cooling circuit and engine exhaust from damage.

This procedure is best accomplished by disconnecting the water intake hose from the vessels thru-hull fitting. **Close the intake valve before disconnecting the hose.** Insert the hose end into a large container of fresh water.

Before starting the engine, remove the engine thermostat (replace the gasket and cover). This will ensure a full flow of water thru the engine. **Re-install the thermostat once flushing is complete.**

Run the unit for 10 minutes or longer to adequately flush the cooling system.

Provide an external fresh water supply for the bucket to maintain the water level in the bucket while the unit is being operated during the flushing process.

The fresh water will flush out the engines water passages and exhaust lines. If the engine is being stored and there is a probability of freezing, flush the engine with fresh water and then prior to shutting the unit down substitute the fresh water supply with a concentrated antifreeze mixture and run this through the engine to provide freeze and corrosion protection for both the engine and exhaust system.

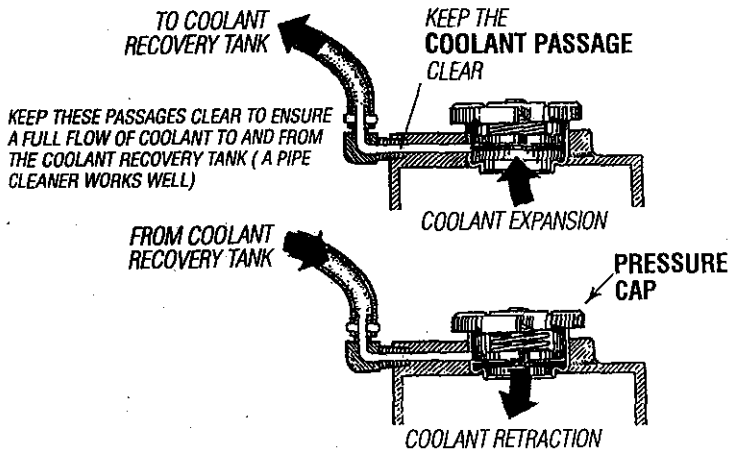
When recommissioning, make certain the valves and seacocks are open so the engine will quickly receive fresh water. if the engine is stowed where it is warm, the fresh water can stay in the engine.

FRESH WATER COOLING CIRCUIT

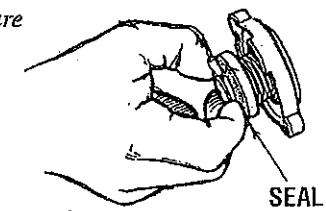
NOTE: *Refer to the ENGINE COOLANT section for the recommended antifreeze and water mixture to be used as the fresh water coolant.*

Fresh water coolant is pumped through the engine by a circulating pump, absorbing heat from the engine. The coolant then passes through the thermostat into the manifold, to the heat exchanger where it is cooled, and returned to the engine block via the suction side of the circulating pump.

When the engine is started cold, external coolant flow is prevented by the closed thermostat (although some coolant flow is bypassed around the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens, allowing full flow of the engine's coolant to flow unrestricted to the external portion of the cooling system.


TO COOLANT RECOVERY TANK
KEEP THE COOLANT PASSAGE CLEAR
KEEP THESE PASSAGES CLEAR TO ENSURE A FULL FLOW OF COOLANT TO AND FROM THE COOLANT RECOVERY TANK (A PIPE CLEANER WORKS WELL)
COOLANT EXPANSION
FROM COOLANT RECOVERY TANK
PRESSURE CAP
COOLANT RETRACTION

NOTE: *Periodically check the condition of the manifold pressure cap. Ensure the upper and lower rubber seals are in good condition. Check to ensure the vacuum valve opens and closes tightly. Carry a spare cap. Check also to ensure the coolant passage is clear so coolant within the system is able to expand and contract to and from the coolant recovery tank.*



Coolant Recovery Tank

A coolant recovery tank allows for engine coolant expansion and contraction during engine operation, without any significant loss of coolant and without introducing air into the cooling system. This tank should be located at or above the engine manifold level and should be easily accessible.

NOTE: *This tank, with its short run of plastic hose, is best located at or above the level of the engine's manifold.*

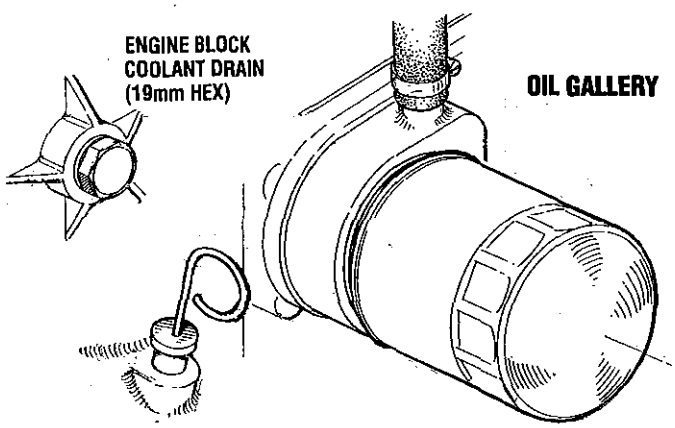
CHANGING COOLANT

The engine's coolant must be changed according to the *MAINTENANCE SCHEDULE*. If the coolant is allowed to become contaminated, it can lead to overheating problems.

> ⚠ **CAUTION:** ***Proper cooling system maintenance is critical; a substantial number of engine failures can be traced back to cooling system corrosion.***

Drain the engine coolant by loosening the drain plug on the engine block and opening the manifold pressure cap. Flush the system with fresh water, then start the refill process.

NOTE: *The drain on the heat exchanger should also be used to help drain engine coolant.*



Refilling the Coolant

After closing the engine block drain, pour clean, premixed coolant into the manifold and when the coolant is visible in the manifold, start the engine and run it at slow idle. Open the air bleed petcocks on the manifold and the thermostat housing.

Monitor the coolant in the manifold and add as needed. Fill the manifold to the filler neck and when the coolant flowing from the petcock is free of air bubbles, close the petcock and install the pressure cap.

Remove the cap on the coolant recovery tank and fill with coolant mix to halfway between LOW and MAX and replace the cap. Run the engine and observe the coolant expansion flow into the recovery tank. When the petcock on the thermostat housing is free of air bubbles, close that petcock.

After checking for leaks, stop the engine and allow it to cool. Coolant should draw back into the cooling system as the engine cools down. Add coolant to the recovery tank if needed. Clean up any spilled coolant.

> ⚠ **WARNING:** ***Beware of the hot engine coolant. Wear protective gloves.***

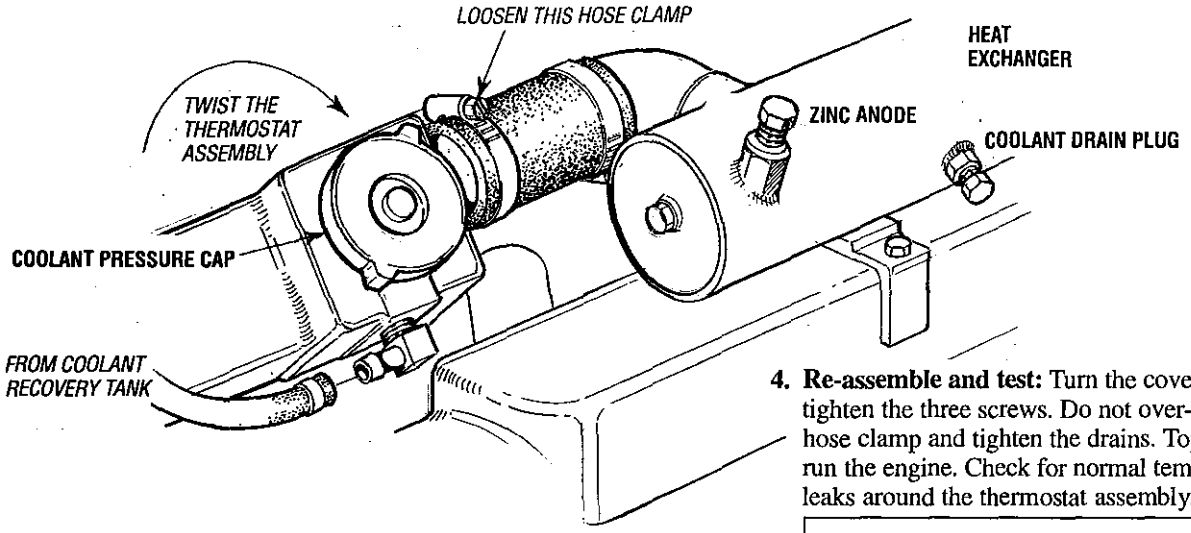
COOLING SYSTEM

THERMOSTAT

A thermostat, located near the manifold at the front of the engine, controls the coolant temperature as the coolant continuously flows through the closed cooling circuit. When the engine is first started, the closed thermostat prevents coolant from flowing (some coolant is by-passed through a hole in the thermostat to prevent the exhaust manifold from overheating). As the engine warms up, the thermostat gradually opens. The thermostat is accessible and can be checked, cleaned, or replaced easily. Carry a spare thermostat and gasket.

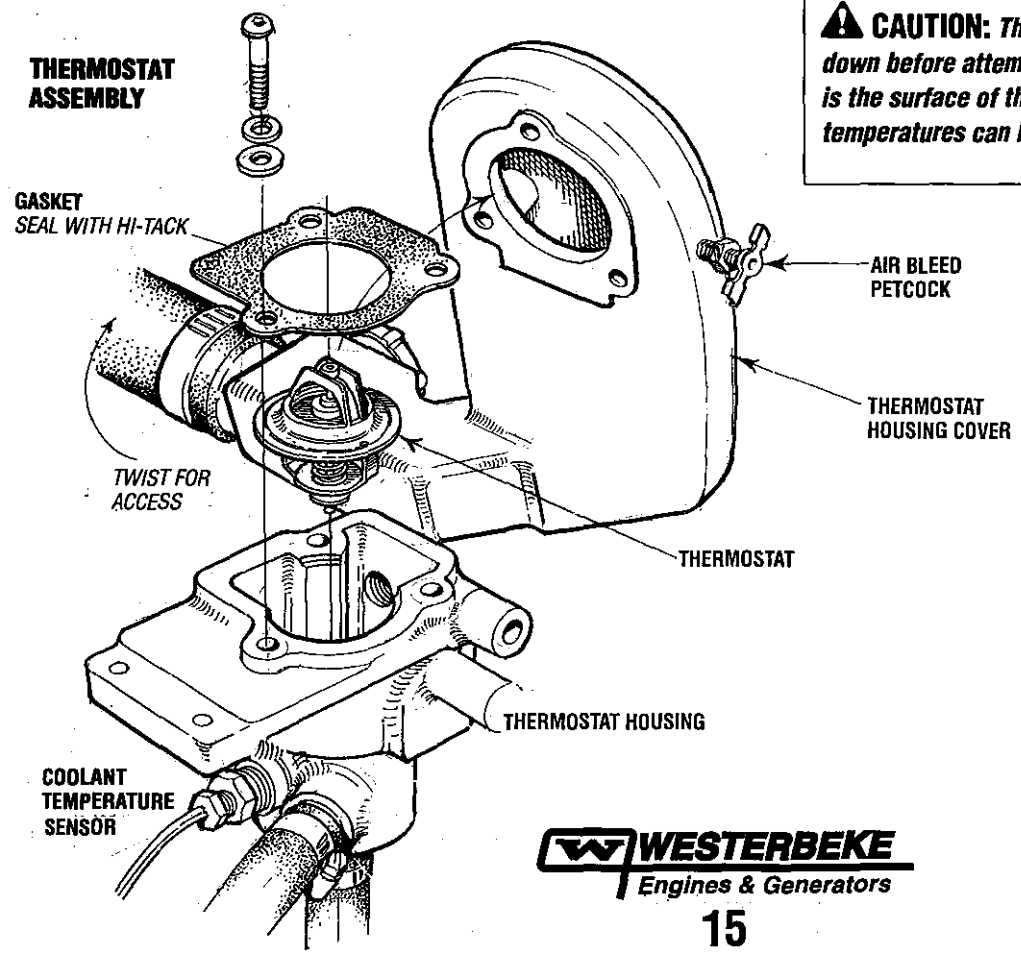
REPLACING THE THERMOSTAT

1. **Drain off some coolant**: Release the coolant pressure cap and drain the coolant to the approximate level off the thermostat housing. This can be done using the heat exchanger drain plug.
2. **Rotate the thermostat assembly:** Loosen the hose clamp as shown and remove the three allen screws that hold down the thermostat housing cover, the assembly can now be twisted enough to access the gasket and thermostat.
3. **Remove/replace the gasket and thermostat:** When installing the new parts, apply a thin coat of sealant on both side of the gasket before pressing it into place.



4. **Re-assemble and test:** Turn the cover back into place and tighten the three screws. Do not over-tighten! Tighten the hose clamp and tighten the drains. Top off the coolant and run the engine. Check for normal temperature and for any leaks around the thermostat assembly.

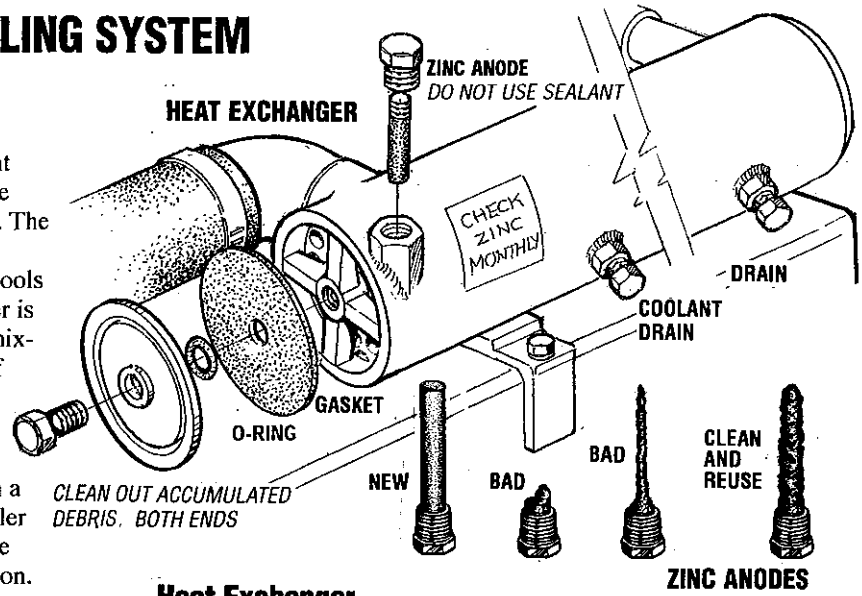
> ⚠ **CAUTION:** ***The engine must be allowed to cool down before attempting these procedures. Not only is the surface of the engine hot but coolant temperatures can be at 190° F.***



COOLING SYSTEM

RAW WATER COOLING CIRCUIT

The raw water flow is created by a positive displacement impeller pump. This pump draws water directly from the ocean, lake, or river through a hose to the water strainer. The raw water passes from the strainer through the heat exchanger (through the heat exchanger tubes) where it cools the engine circulating fresh water coolant. The raw water is then discharged into the water injected exhaust elbow, mixing with and cooling the exhaust gasses. This mixture of exhaust gas and raw water is pushed overboard.



Raw Water Pump

The raw water pump is a self-priming, rotary pump with a non-ferrous housing and a neoprene impeller. The impeller has flexible vanes which wipe against a curved cam plate within the impeller housing, producing the pumping action. On no account should this pump be run dry as water acts as a lubricant for the impeller. There should always be a spare impeller and impeller cover gasket aboard (an impeller kit). Raw water pump impeller failures occur when lubricant (raw water) is not present during engine operation. Such failures are not warrantable, and operators are cautioned to make sure raw water flow is present at start-up.

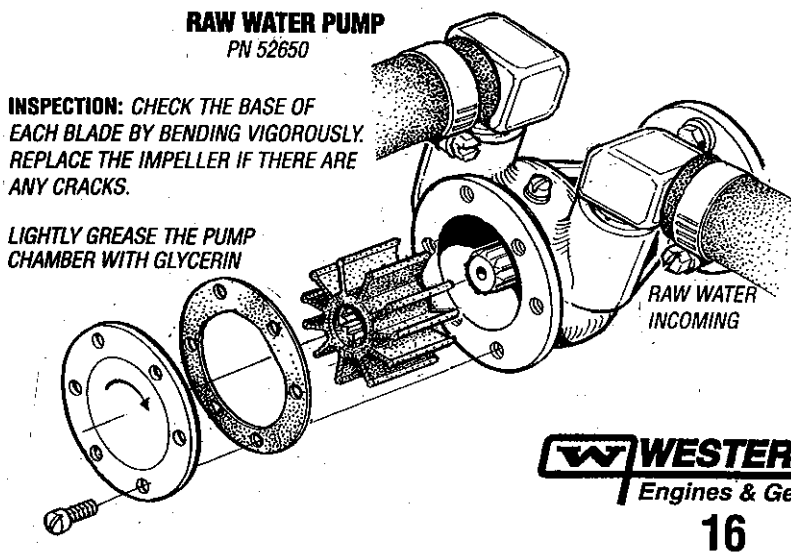
NOTE: *Should a failure occur with the pumps internal parts (seals and bearings), it may be more cost efficient to purchase a new pump and rebuild the original pump as a spare.*

Inspecting/Changing the Raw Water Pump Impeller

Close the raw water intake valve. Remove the pump cover and, with the proper size impeller tool, carefully pry the impeller out of the pump (the impeller can be pried out using a pair of screwdrivers if an impeller puller is unavailable. Take care not to tear the impeller). Install the new impeller and gasket. Move the blades to conform to the curved cam plate and push the impeller into the pumps housing. When assembling, apply a thin coating of lubricant to the impeller and gasket. **Open the raw water intake valve.**

Run the engine and check for leaks around the pump. Also check for water discharge at the stern tube. Absence of water flow indicates the pump has not primed itself properly.

NOTE: *Never allow the pump to run dry. Even a short period of dry running may destroy the impeller.*


RAW WATER PUMP
PN 52650
INSPECTION: CHECK THE BASE OF EACH BLADE BY BENDING VIGOROUSLY. REPLACE THE IMPELLER IF THERE ARE ANY CRACKS.
LIGHTLY GREASE THE PUMP CHAMBER WITH GLYCERIN
RAW WATER INCOMING

Heat Exchanger

The heat exchanger is a copper tube which encloses a number of small copper tubes. Raw water is pumped through the small copper tubes and the freshwater coolant from the engine is circulated around the copper tubes. The raw water removes heat from the freshwater coolant.

Zinc Anode

A zinc anode, or pencil, is located in the raw water cooling circuit within the heat exchanger. The purpose of the zinc anode is to sacrifice itself to electrolysis action taking place in the raw water cooling circuit, thereby reducing the effects of electrolysis on other components of the system. The condition of the zinc anode should be checked monthly and the anode cleaned or replaced as required. Spare anodes should be carried on board.

NOTE: *Electrolysis action is the result of each particular installation and vessel location; not that of the generator.*

If the zinc pencil needs replacement, hold the hex boss into which the zinc pencil is threaded with a wrench while loosening the anode with another wrench. This prevents the hex boss from possibly tearing off the exchanger shell. After removing the zinc, note the condition of it. If the zinc is in poor condition, there are probably a lot of zinc flakes within the exchanger. Remove the end of the heat exchanger and clean the inside of all zinc debris. Always have a spare heat exchanger end gasket in case the present one becomes damaged when removing the end cover. Replace the gasket (refer to your engine model's heat exchanger end gasket part number), o-ring, cover, and install a new zinc pencil.

Heat Exchanger Service

After approximately 1000 hours of operation, remove, clean and pressure test the engine's heat exchanger. (A local automotive radiator shop should be able to clean and test the heat exchanger.)

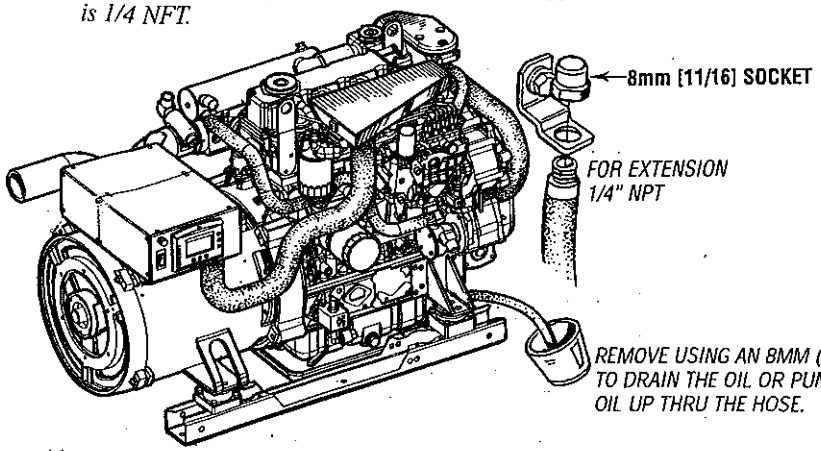
NOTE: *Operating in silty and/or tropical waters may require that a heat exchanger cleaning be performed more often than every 1000 hours.*

ENGINE LUBRICATING OIL

ENGINE OIL CHANGE

1. ***Draining the oil sump.*** Discharge the used oil through the sump drain hose (attached to the front of the engine) while the engine is warm. Drain the used oil completely, replace the hose in its bracket and replace the end cap securely.

NOTE: *Thread size for the lube oil drain hose capped end is 1/4 NFT.*


8mm [11/16] SOCKET
FOR EXTENSION 1/4" NPT
REMOVE USING AN 8MM (11/16") SOCKET TO DRAIN THE OIL OR PUMP THE WARMED OIL UP THRU THE HOSE.

Always observe the used oil as it is removed. A yellow/gray emulsion indicates the presence of water in the oil. Although this condition is rare, it does require prompt attention to prevent serious damage. Call a qualified mechanic should water be present in the oil. Raw water present in the oil can be the result of a fault in the exhaust system attached to the engine and/or a siphoning of raw water through the raw water cooling circuit into the exhaust, filling the engine. This problem is often caused by the absence of an anti-siphon valve, its poor location or lack of maintenance.

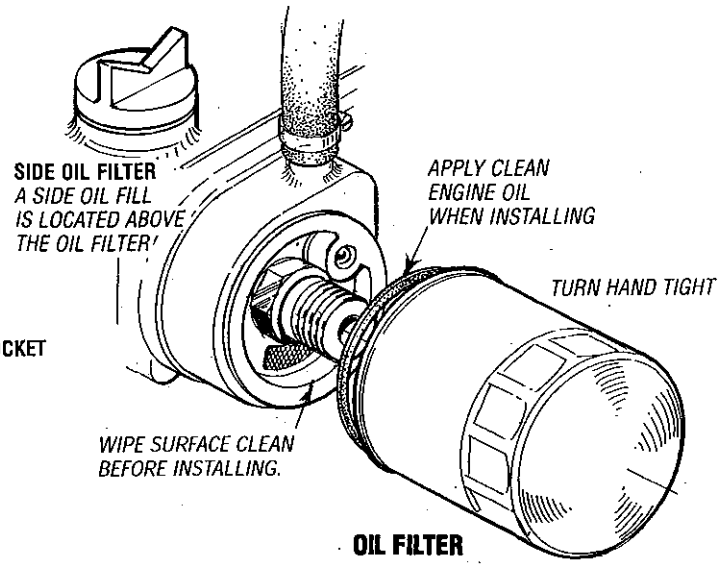
2. ***Replacing the oil filter.*** When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage. A small automotive filter wrench should be helpful in removing the old oil filter.

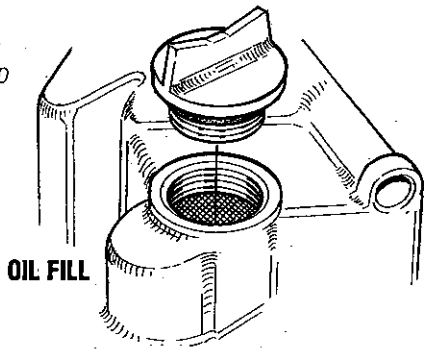
NOTE: *Do not punch this hole without first loosening the filter to make certain it can be removed.*

Place some paper towels and a plastic bag around the filter when unscrewing it to catch any oil left in the filter. (Oil or any other fluid on the engine reduces the engine's cooling ability. Keep your engine clean.) Inspect the old oil filter as it is removed to make sure that the rubber sealing gasket comes off with the old filter. If this rubber sealing gasket remains sealed against the filter bracket, gently remove it.

When installing the new oil filter element, wipe the filter gasket's sealing surface on the bracket free of oil and apply a thin coat of clean engine oil to the rubber gasket on the new oil filter. Screw the filter onto the threaded oil filter nipple on the oil filter bracket, and tighten the filter firmly by hand.

NOTE: *The engine oil is cooled by engine coolant flowing through passages in the oil filter bracket housing assembly.*


SIDE OIL FILTER
A SIDE OIL FILL IS LOCATED ABOVE THE OIL FILTER
APPLY CLEAN ENGINE OIL WHEN INSTALLING
TURN HAND TIGHT
WIPE SURFACE CLEAN BEFORE INSTALLING.
OIL FILTER



NOTE: *Generic filters are not recommended, as the material standards or diameters of important items on generic parts might be entirely different from genuine parts. Immediately after an oil filter change and oil fill, run the engine to make sure the oil pressure is normal and that there are no oil leaks around the new oil filter.*

3. ***Filling the Oil Sump.*** Add new oil through the oil filler cap on the top of the engine. After refilling, run the engine for a few moments while checking the oil pressure. Make sure there is no leakage around the new oil filter or from the oil drain system, and stop the engine. Then check the quantity of oil with the lube oil dipstick. Fill to, but not over the high mark on the dipstick, should the engine require additional oil.

⚠ WARNING: ***Used engine oil contains harmful contaminants. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water. Launder or discard clothing or rags containing used oil. Discard used oil properly.***

REMOTE OIL FILTER (OPTIONAL)

INSTALLATION

This popular accessory is used to relocate the engine's oil filter from the engine to a more convenient location such as an engine room bulkhead.

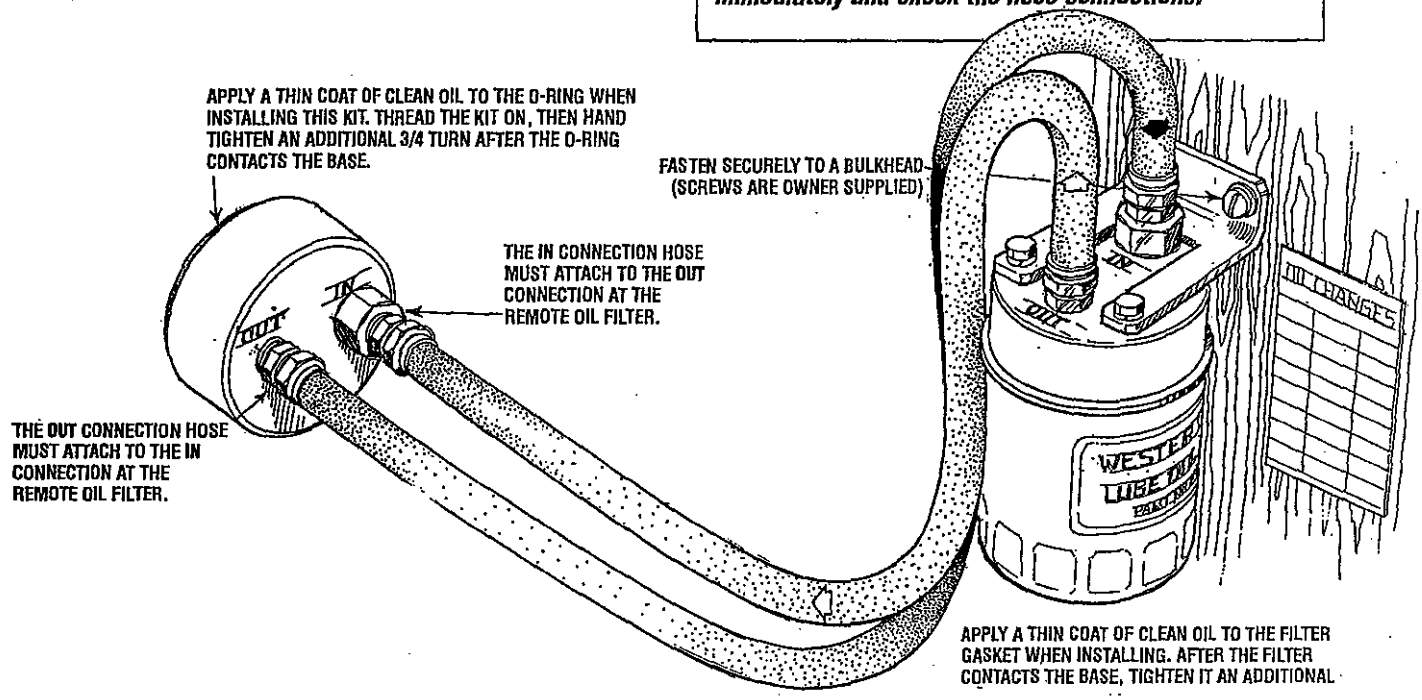
NOTE: *Refer to ENGINE OIL CHANGE in this manual for instructions on removing the oil filter.*

To install, simply remove the engine oil filter and thread on WESTERBEKE's remote oil filter kit as shown. Always install this kit with the oil filter facing down as illustrated.

Contact your WESTERBEKE dealer for more information.

NOTE: *Westerbeke is not responsible for engine failure due to incorrect installation of the Remote Oil Filter.*

⚠ CAUTION: ***It is vital to install the oil lines correctly. If the oil flows in the reverse direction, the bypass valve in the filter assembly will prevent the oil from reaching the engine causing an internal engine failure. If there is no oil pressure reading, shutdown immediately and check the hose connections.***


APPLY A THIN COAT OF CLEAN OIL TO THE O-RING WHEN INSTALLING THIS KIT. THREAD THE KIT ON, THEN HAND TIGHTEN AN ADDITIONAL 3/4 TURN AFTER THE O-RING CONTACTS THE BASE.
FASTEN SECURELY TO A BULKHEAD (SCREWS ARE OWNER SUPPLIED)
THE IN CONNECTION HOSE MUST ATTACH TO THE OUT CONNECTION AT THE REMOTE OIL FILTER.
THE OUT CONNECTION HOSE MUST ATTACH TO THE IN CONNECTION AT THE REMOTE OIL FILTER.
APPLY A THIN COAT OF CLEAN OIL TO THE FILTER GASKET WHEN INSTALLING. AFTER THE FILTER CONTACTS THE BASE, TIGHTEN IT AN ADDITIONAL
IN
OUT
OIL CHANGES

STARTER MOTOR

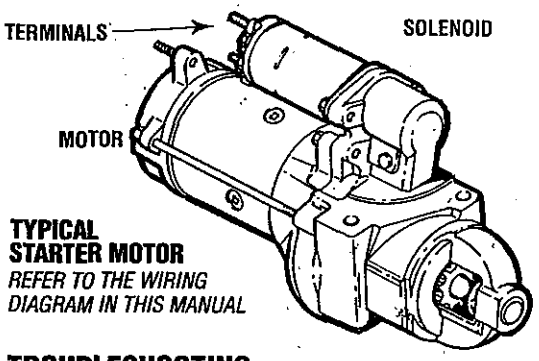
DESCRIPTION

The starting system includes the battery, starter motor, solenoid, and starter button.

When the starter button on the instrument panel is depressed, current flows and energizes the starter's solenoid coil. The energized coil becomes an electromagnet, which pulls the plunger into the coil, and closes a set of contacts which allow high current to reach the starter motor. At the same time, the plunger also serves to push that starter pinion to mesh with the teeth on the flywheel.

To prevent damage to the starter motor when the engine starts, the pinion gear incorporates an over-running (one-way) clutch which is splined to the starter armature shaft. The rotation of the running engine may speed the rotation of the pinion but not the starter motor itself.

Once the started button is released, the current flow ceases, stopping the activation of the solenoid. The plunger is pulled out of contact with the battery-to-start cables by a coil spring, and the flow of electricity is interrupted to the starter. This weakens the magnetic fields and the starter ceases its rotation. As the solenoid plunger is released, its movement also pulls the starter drive gear from its engagement with the engine flywheel.



TYPICAL STARTER MOTOR
REFER TO THE WIRING DIAGRAM IN THIS MANUAL

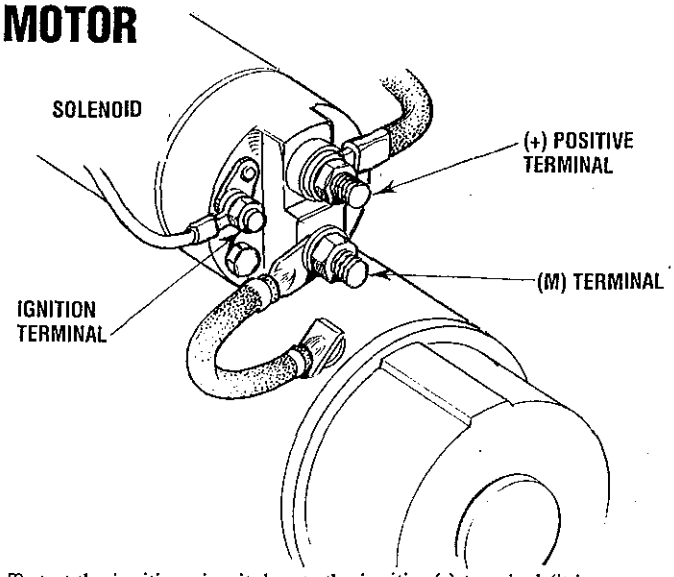
TROUBLESHOOTING

Prior to testing, make certain the ships batteries are at full charge and that the starting system wiring connections (terminals) are clean and tight. Pay particular attention to the ground wire connections on the engine block.

To check the wiring, try cranking the starter for a few seconds, never more than 10 seconds at a time, then run your hand along the wires and terminals looking for warm spots that indicate resistance. Repair or replace any trouble spots.

Using a multimeter, test the voltage between the positive terminal stud on the start solenoid and the engine block (ground).

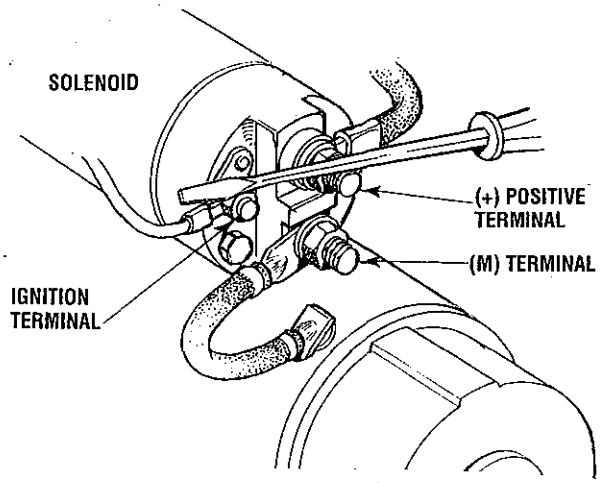
If you read 12 volts, the starter is faulty.



To test the ignition circuit, locate the ignition(s) terminal (it is one of the small terminal studs and is wired to the ignition circuit). Use a screwdriver, don't touch the blade, to jump from that ignition terminal to the positive battery connection terminal on the solenoid.

If the starter cranks, the fault lies with the ignition circuit.

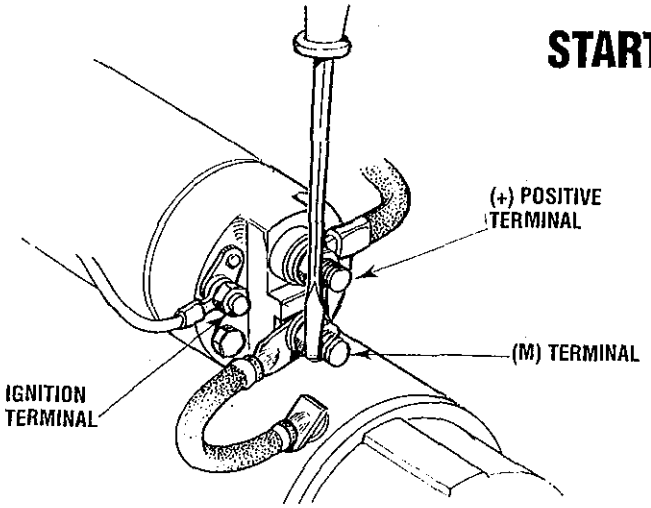
If the solenoid clicks but nothing else happens, the starter motor is probably faulty.



If nothing at all happens the solenoid isn't getting current. Check the battery isolation switch and inspect the wiring connections. It is also possible that the solenoid is defective.

> ⚠ **WARNING:** ***There will be arching and sparks will fly when jumping terminals. Be certain the engine space is free of potentially explosive fumes, especially gasoline.***

STARTER MOTOR



Test again by jumping the two large terminal studs. Hold the screwdriver blade firmly between the studs. Do not allow the screwdriver blade to touch the solenoid or starter casing, this would cause a short.

> ⚠ **WARNING:** ***There will be arching as the full starting current should be flowing thru the blade of the screwdriver.***

If the starter spins, the solenoid is faulty.

If the starter fails to spin, the motor is probably faulty.

If no arching occurred. There is no juice reaching the solenoid.

NOTE: *Starter motors are either inertia type or pre-engaged. In the pre-engaged model, the solenoid also moves an arm that engages the starter motor to the flywheel of the engine. Using a screwdriver to bypass the solenoid on such a starter will run the motor without engaging the flywheel. Turn the starter switch on to provide the power to the solenoid. Hopefully it will create enough magnetic field for the arm to move even though the contacts inside the solenoid are bad.*

SERVICE

Westerbeke uses a standard marine starter motor which can be serviced or rebuilt at any starter motor automotive service center.

If replacing the starter motor, make certain the new motor is certified for marine use. Automotive starters do not meet USCG standards. If in doubt, contact your WESTERBEKE dealer.

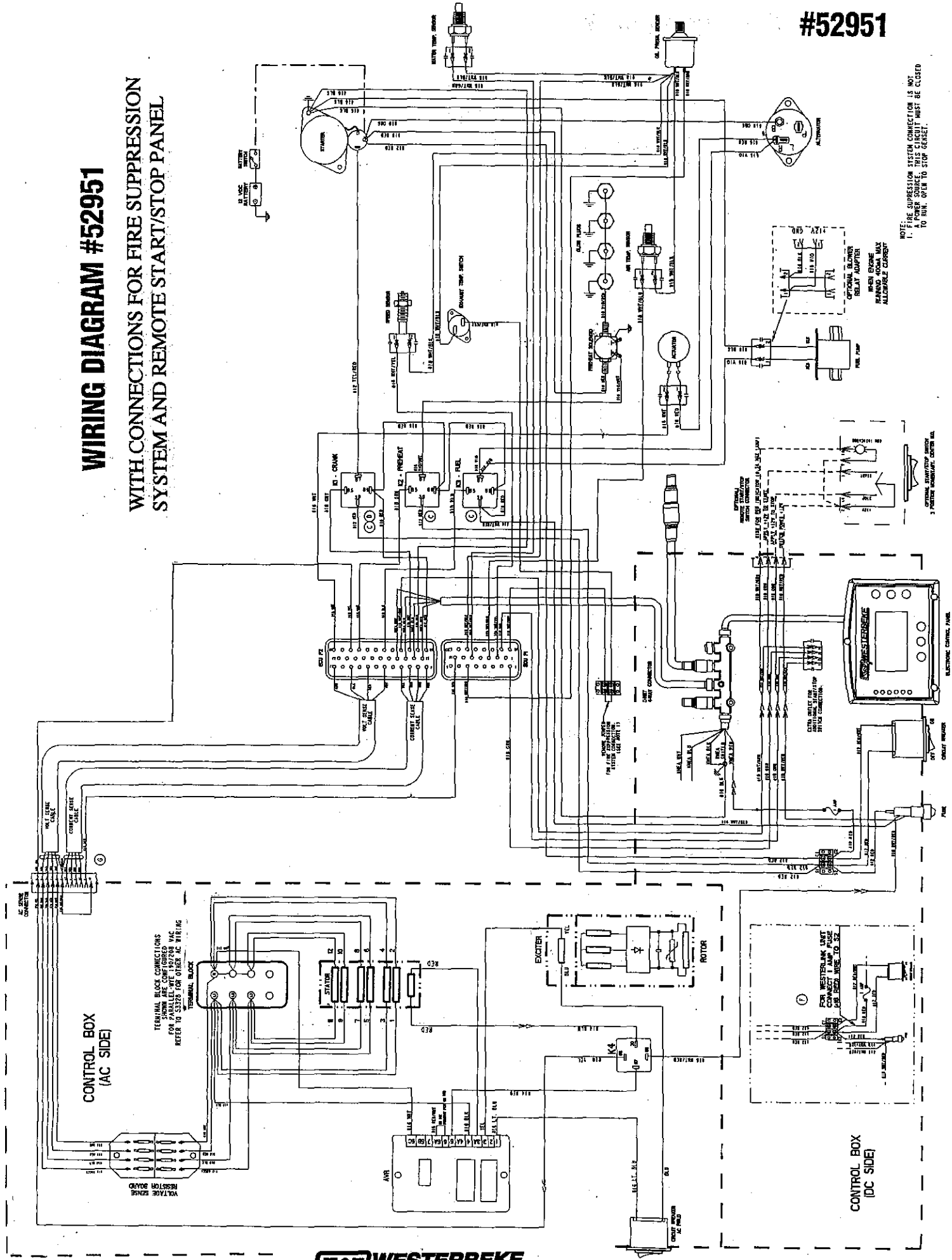
TO REMOVE FOR SERVICE

1. Disconnect the negative battery cable.
2. If necessary, remove any components to gain full access to the starter motor.
3. Label and disconnect the wiring from the starter. (Do not allow wires to touch, tape over the terminals).
4. Remove the starter mounting bolts.
5. Remove the starter from the engine. In some cases the starter will have to be turned to a different angle to clear obstructions.

#52951

WIRING DIAGRAM #52951

WITH CONNECTIONS FOR FIRE SUPPRESSION SYSTEM AND REMOTE START/STOP PANEL



ENGINE TROUBLESHOOTING

The following troubleshooting table describes certain problems relating to engine service, the probable causes of the problems, and the recommendations to overcome these problems.

Note: *The engine's electrical system is protected by a 20 amp manual reset circuit breaker located on a bracket at the rear of the engine.*

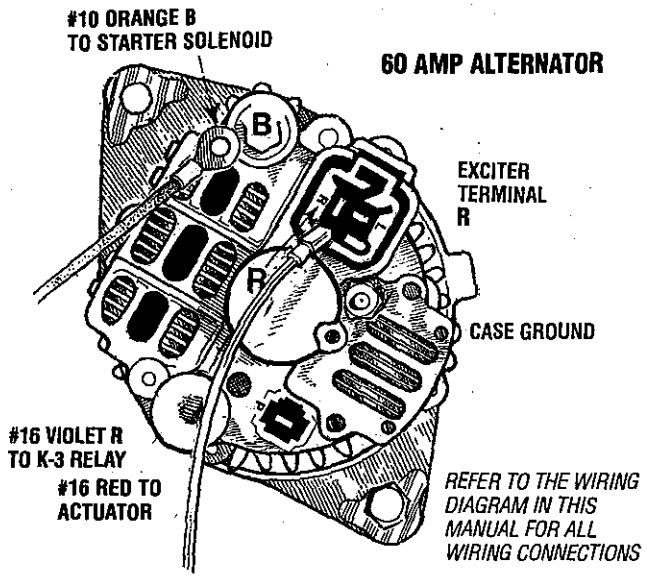
Problem	Probable Cause	Verification/Remedy
START BUTTON depressed, no panel indications.	1. Battery Switch not on. 2. Circuit breaker tripped/off. 5. Loose battery connections.	1. Check switch and/or battery connections. 2. Reset breaker; if breaker trips again, check preheat solenoid circuit and check circuit for shorts to ground. 4. Check (+) connection to starter solenoid and (-) connection to engine ground stud. Check battery cable connections.
START BUTTON depressed, no starter engagement.	1. Connection to solenoid faulty. 2. Faulty solenoid. 3. Loose battery connections. 4. Low battery. 5. K1 relay.	1. Check connection. 2. Check that 12 volts are present at the solenoid connection. 3. Check battery connections. 4. Check battery charge state. 5. Check K1 relay.
START BUTTON depressed; panel indications OK; starter solenoid OK fuel solenoid not functioning.	1. Poor connections to fuel solenoid. 2. Defective fuel solenoid.	1. Check connections. 2. Check that 12 volts are present at the (+) connection on the fuel run solenoid.
Generator engine cranks, but does not start, fuel solenoid energized.	1. Faulty fueling system. 2. Preheat solenoid faulty.	1. Check that fuel valves are open. **1a.** Switch to combine house and start batteries. **1b.** Replace batteries. **1c.** Check fuel lift pump. **1d.** Change inlet fuel filter. 2. Check solenoid.
Battery runs down.	1. High resistance leak to ground. 2. Low resistance leak. 3. Poor battery connections. 4. DC alternator not charging.	1. Check wiring. Insert sensitive (0 - .25 amp) meter in battery lines. **Do not start engine.** Remove connections and replace after short is located. 2. Check all wires for temperature rise to locate the fault. 3. Check cable connections at battery for loose connections, corrosion. 4. Check connections, check belt tension. test alternator. See *DC ELECTRICAL SYSTEM/ALTERNATOR.*
Battery not charging	1. DC charge circuit faulty. 2. Alternator drive.	1. Perform D.C. voltage check of generator charging circuit. See *DC ELECTRICAL SYSTEM/ALTERNATOR* in this manual. 2. Check drive belt tension. Alternator should turn freely. Check for loose connections. Check output voltmeter. Ensure 12 volts are present at the Exc. terminal.
Generator engine stops.	1. Fuel lift pump failure. er is dirty. 2. Switches and/or wiring loose or disconnected. 3. Fuel starvation. 4. 20 Amp circuit breaker tripping. 5. Exhaust system is restricted. 6. Water in fuel. 7. Air intake obstruction.	1. Fuel lift pump should make a distinct ticking sound. Replace. 2. Inspect wiring for short circuits and loose connections. Inspect switches for proper operation. 3. Check fuel supply, fuel valves, Fuel filters, fuel lift pump. 4. Check for high DC amperage draw during operation. Ensure breaker is not overly sensitive to heat which would cause tripping. 5. Check for blockage or collapsed muffler. 6. Pump water from fuel tank(s); change filters and bleed fuel system. 7. Check air intake.
Engine starts, runs and shuts down	1. Oil pressure switch. 2. Water temperature switch.	1. Check oil pressure switch. 2. Check water temperature switch.
Engine starts, runs at idle	1. Electronic governor system faulty	1. Check governor system components.

(continued)

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification/Remedy
Exhaust smoking problems	**1.** Blue smoke.	**1.** Incorrect grade of engine oil.
		1a. Crankcase is overfilled with engine oil (oil is blowing out through the exhaust).
	2. White smoke.	**2.** Engine is running cold.
		2a. Faulty injector or incorrect injector timing.
	3. Black smoke.	**3.** Improper grade of fuel.
		3a. Fuel burn incomplete due to high back pressure in exhaust or insufficient air for proper combustion (Check for restrictions in exhaust system; check air intake.).
		3b. Improperly timed injectors or valves or poor compression.
		3c. Lack of air — check air intake and air filter. Check for proper ventilation.
		3d. Overload.
LCD DISPLAYS No LCD Display	**1.** Check battery. **2.** 20 amp breaker off.	**1.** Battery on. **2.** Turn breaker on.
Oil Pressure	**1.** Oil level low/oil leak.	**1.** Check oil level, add oil and repair leaks.
	2. Lack of oil pressure.	**2.** Test oil pressure. If OK, test oil pressure sendor, inspect oil filter, inspect oil pump.
	3. Ground connection.	**3** Check ground circuit.
	4. Faulty control module.	**4.** Inspect all plug connections/replace.
Coolant Temperature	**1.** Check system coolant level.	**1.** Add coolant. Check for leaks.
	2. Check water pump drive belt.	**2.** Test oil pressure, replace belt.
	3. Faulty Temperature sensor.	**3** Check sensor/replace.
	4. Ground connection.	**4.** Check ground circuit.
	5. Faulty control module.	**5.** Check plug connections/replace.
Exhaust Temperature/External Fault	**1.** Check sea water flow.	**1.** Inspect thru hull fitting, hose and strainer. Correct as needed.
	2. Faulty exhaust temperature switch.	**2.** Test/replace.
	3. Ground connection.	**3** Check ground circuit.
	4. Faulty control module.	**4.** Check plug connections.
	5. Sea water pump.	**5.** Inspect impeller/replace.
	6. Fire suppressor system.	**6.** Check system/by-pass.
Battery Voltage	**1.** Check alternator drive belt.	**1.** Adjust tension/replace if worn.
	2. Check charge voltage.	**2.** Check excitation, replace/repair alternator.
	3. Check battery connections.	**3** Check + and - cables from battery to engine.
	4. Faulty control module.	**4.** Check plug connections/replace.
Generator Voltage	**1.** Check AC voltage output.	**1.** Adjust voltage/troubleshoot generator for cause.
	2. Improper voltage sense connections.	**2.** Check connections.
	3. Faulty control module.	**3** Check plug connections/replace.
Generator Frequency	**1.** Check Engine speed.	**1.** Adjust.
	2. Check fuel supply.	**2.** Inspect filters/replace filters. Test fuel pump operation.
	3. Amperage load.	**3** Check load with amprobe.
LED Display Edges turn pink	**1.** Compartment ambient temperature too high.	**1.** Ventilate compartment. **Note:** *Heat will often change the color of an ICD display. This will not effect the operation of the engine.*
Waiting for ECU	**1.** ECU or display	**1.** Check compatibility of ECU/display for NEMA 2000 or Westlink.

ALTERNATORS TESTING/TROUBLESHOOTING



DESCRIPTION

The following information applies to the standard alternators that are supplied with WESTERBEKE'S Engines and Generators.

ELECTRICAL CHARGING CIRCUIT

The charging system consists of an alternator with a voltage regulator, an engine DC wiring harness, a mounted DC circuit breaker and a battery with connecting cables. Because of the use of integrated circuits (IC's), the electronic voltage regulator is very compact and is mounted internally or on the back of the alternator.

It is desirable to test the charging system (alternator and voltage regulator) using the wiring harness and electrical loads that are a permanent part of the system and will then provide the technician with an operational test of the charging system as well as the major components of the electrical system.

ALTERNATOR DESCRIPTION

The stator is connected to a three-phase, full-wave bridge rectifier package which contains six diodes. The bridge converts the AC generated in the stator to a DC output for battery charging and accessories,

Power to the regulator and the field of the integral regulator alternator is provided by the field diode (or diode trio) package contained in the alternator.

These alternators produce a rated output of 60 amps. Rated output is achieved at approximately 6000 alternator rpm at an ambient temperature of 75°F (23.8°C). The alternators are designed to operate in an ambient temperature range of -40° to 212°F (-40° to 100°C).

VOLTAGE REGULATOR

The integral voltage regulator is an electronic switching device which senses the system voltage level and switches the voltage applied to the field in order to maintain a proper system voltage.

The regulator design utilizes all-silicon semi conductors and thick-film assembly techniques. After the voltage has been adjusted to the proper regulating valve, the entire circuit is encapsulated to protect the circuit and the components from possible damage due to handling or vibration.

ALTERNATOR TROUBLESHOOTING

Use this troubleshooting section to determine if a problem exists with the charging circuit or with the alternator. If it is determined that the alternator or voltage regulator is faulty, have a qualified technician check it.

> ⚠ **WARNING:** ***A working alternator runs hot. A failed alternator can become very hot. Do not touch the alternator until if has cooled.***

LOW BATTERY/FAULTY CIRCUIT

If the starter only moans or makes a clicking sound instead of spinning the engine to life it is likely a low battery or a faulty connection in the starting circuit and not an alternator problem.

PRELIMINARY INSPECTION

Before starting the actual alternator and voltage regulator, testing the following checks are recommended.

1. Make certain your alternator is securely mounted.
2. Check the drive belts for proper tension. Replace the belt if it is worn or glazed.
3. Check that all terminals, connectors and plugs are clean and tight. Loose or corroded connections cause high resistance and this could cause overcharging, undercharging or damage to the charging system. Badly corroded battery cables could prevent the battery from reaching a fully charged condition.
4. Check the condition of the battery and charge if necessary. A low or discharged battery may cause false or misleading readings in the tests.

NOTE: *An isolator with a diode, a solenoid, or a battery selector switch is usually mounted in the circuit to isolate the batteries so the starting battery is not discharged along with the house batteries. If the isolator is charging the starting battery but not the house battery, the alternator is OK and the problem is in the battery charging circuit.*

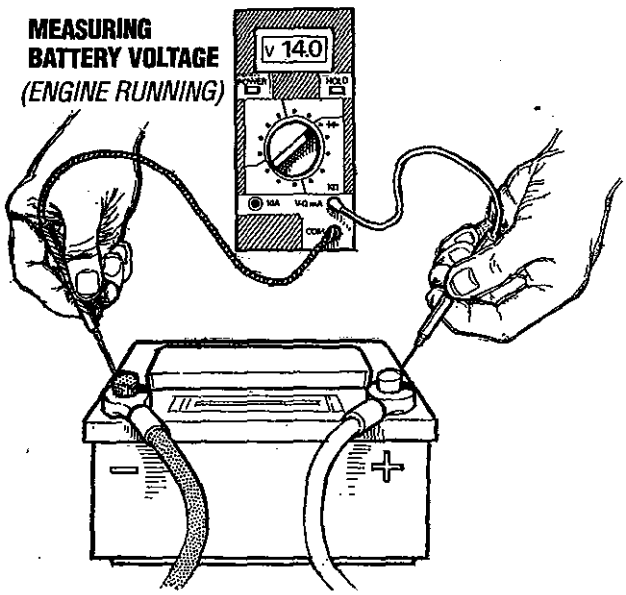
ALTERNATORS TESTING/TROUBLESHOOTING

TESTING THE ALTERNATOR

> **⚠ CAUTION:** ***Before starting the engine make certain that everyone is clear of moving parts! Keep away from sheaves and belts during test procedures.***

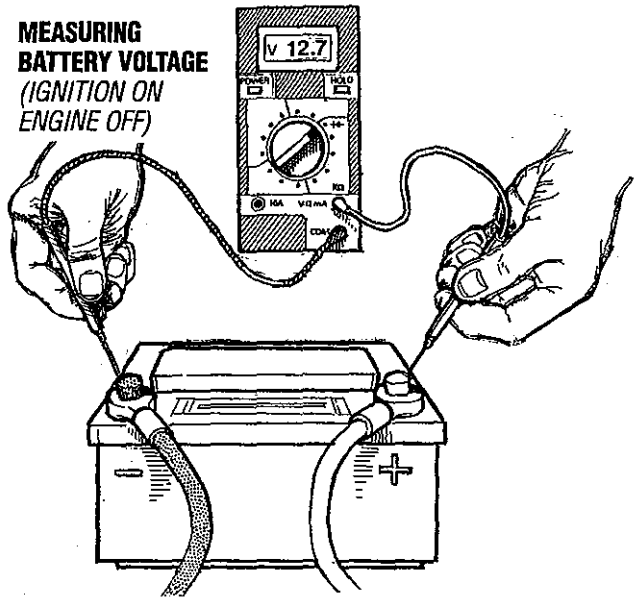
1. **Start the Engine.**
2. After the engine has run for a few minutes, measure the starting battery voltage at the battery terminals using a multimeter set on DC volts.
   a. If the voltage is increasing toward 14 volts, the alternator is working.
   b. If the voltage remains around 12 volts, a problem exists with either the alternator or the charging circuit; continue with Steps 3 through 6.

MEASURING BATTERY VOLTAGE *(ENGINE RUNNING)*



3. **Turn off the engine.** Inspect all wiring and connections. Ensure that the battery terminals and the engine ground connections are tight and clean
4. If a battery selector switch is in the charging circuit,ensure that it is on the correct setting.
5. **Turn on the ignition switch, but do not start the engine.**
6. Check the battery voltage. If your battery is in good condition the reading should be 12 to 13 volts.

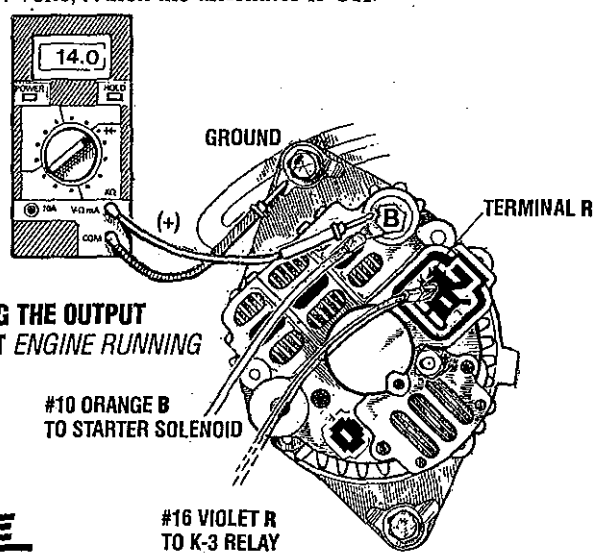
MEASURING BATTERY VOLTAGE *(IGNITION ON ENGINE OFF)*



TESTING THE OUTPUT CIRCUIT

1. Connect the positive probe to the output terminal **B** and connect the negative probe to ground.
2. Wiggle the engine wiring harness while observing the voltmeter. The meter should indicate the approximate battery voltage, and should not vary. If no reading is obtained, or if the reading varies, check the alternator output circuit for loose or dirty connections or damaged wiring.
3. **Start the engine.**
4. Repeat the same measurement, the negative probe to ground, the positive probe to **B** with the engine running. The voltage reading should be between 13.5 and 14.5 volts. If your alternator is over or under-charging, have it repaired at a reliable service shop.
5. If the previous test reads only battery voltage at terminal **B**, use the meter to measure the DC excitation terminal. If 12 volts is not present at exciter terminal **R**, inspect the wiring for breaks and poor connections. Jump 12 volts from a 12 volt source (such as the battery) and operate the alternator. If the voltage output is 13-14 volts, . . then the alternator is OK.

TESTING THE OUTPUT CIRCUIT *ENGINE RUNNING*

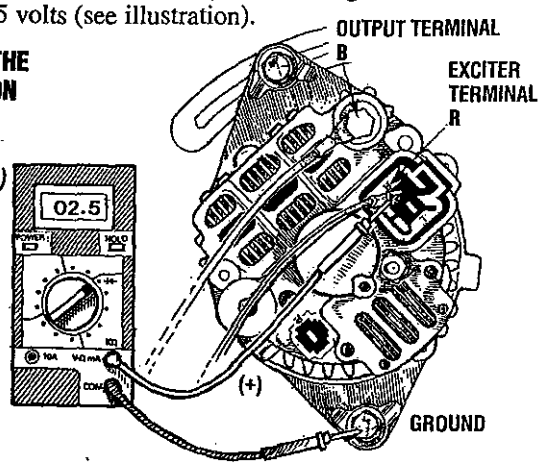


ALTERNATORS TESTING/TROUBLESHOOTING

TESTING THE EXCITATION CIRCUIT

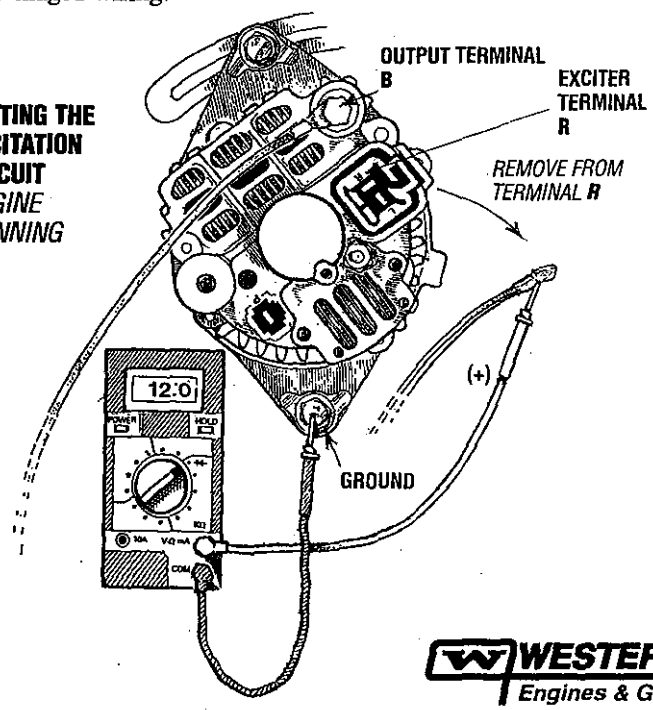
1. Connect the positive (+) multimeter probe to the excitation terminal **R** on the alternator and the negative (–) lead to ground.
2. **Turn the ignition switch to the on position** and note the multimeter reading. The reading should be 1.3 to 2.5 volts (see illustration).

TESTING THE EXCITATION CIRCUIT *(ENGINE RUNNING)*



3. **If the reading is between .75 and 1.1 volts,** the rotor field circuit probably is shorted or grounded.
4. **If the reading is between 6.0 and 7.0 volts,** the rotor field circuit probably is open.
5. **If no reading is obtained,** an open exists in the alternator-excitation lead or in the excitation circuit of the regulator. Disconnect the lead from exc terminal **R**. Connect the positive multimeter probe to the excitation lead and the negative multimeter probe to ground. If the multimeter now indicates an approximate battery voltage, the voltage regulator is defective and must be replaced. If no voltage is indicated, check the excitation circuit for loose or dirty connections or damaged wiring.

TESTING THE EXCITATION CIRCUIT *ENGINE RUNNING*



CHECKING THE SERVICE BATTERY

Check the voltage of the service battery. this battery should have a voltage between 13 and 14 volts when the engine is running. If not, there is a problem in the service battery charging circuit. Troubleshoot the service battery charging circuit by checking the wiring and connections, the solenoid, isolator, battery switch, and the battery itself.

When the problem has been solved and before the alternator is back in operation, take the time to tighten and clean the terminal studs. Also clean the connecting terminals from the wiring harness.

ALTERNATOR REPAIR

If tests indicate a failed alternator, it will need to be disassembled and repaired. Any good alternator service shop can do the job.

NOTE: *WESTERBEKE'S Service Manual has detailed instructions for the disassembly and repair of their standard alternators.*

BATTERY CARE

The minimum recommended capacity of the battery used in the engine's 12 volt DC control circuit is 800-1000 Cold Cranking Amps (CCA).

Review the manufacturer's recommendations and then establish a systematic maintenance schedule for your engine's starting batteries and house batteries.

- Monitor your voltmeter for proper charging during engine operation.
- Check the electrolyte level and specific gravity with a hydrometer.
- Use only distilled water to bring electrolytes to a proper level.
- Make certain that battery cable connections are clean and tight to the battery posts (and to your engine).

GLOW PLUGS

DESCRIPTION

The glow plugs are wired through the preheat solenoid. When PREHEAT is pressed at the control panel this solenoid should "click" on and the glow plug should begin to get hot.

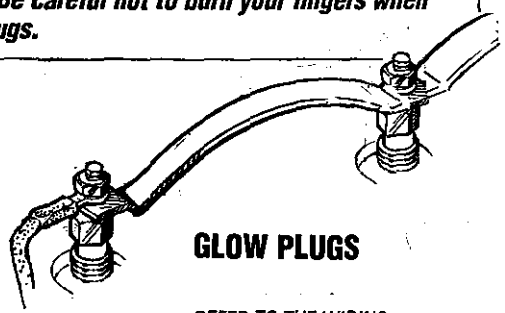
INSPECTION

To inspect the plug, remove the electrical terminal connections, then unscrew or unclamp each plug from the cylinder head. Thoroughly clean each plug's tip and threads with a soft brush and cleaning solution to remove all the carbon and oil deposits. While cleaning, examine the tip for wear and burn erosion; if it has eroded too much, replace the plug.

TESTING

An accurate way to test glow plugs is with an ohmmeter. Touch one prod to the glow plug's wire connection, and the other to the body of the glow plug, as shown. A good glow plug will have a 1.0 - 1.5 ohm resistance. This method can be used with the plug in or out of the engine. You can also use an multimeter to test the power drain (8 - 9 amps per plug).

⚠ WARNING: ***These glow plugs will become very hot to the touch. Be careful not to burn your fingers when testing the plugs.***



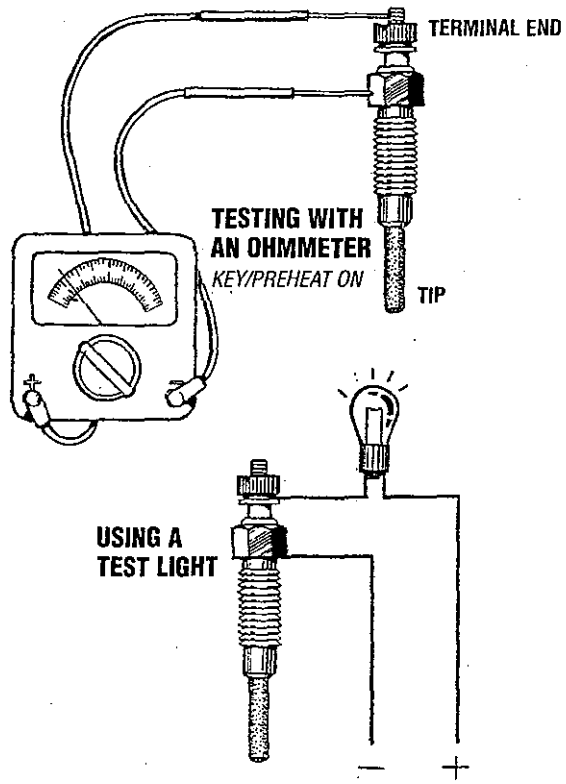
GLOW PLUGS

REFER TO THE WIRING DIAGRAM IN THIS MANUAL FOR ALL WIRING CONNECTIONS

Re-install the plugs in the engine and test them again. The plugs should get very hot (at the terminal end) within 7 to 15 seconds. If the plugs don't heat up quickly, check for a short circuit. When reinstalling the glow plugs, use anti-seize compound on the threads.

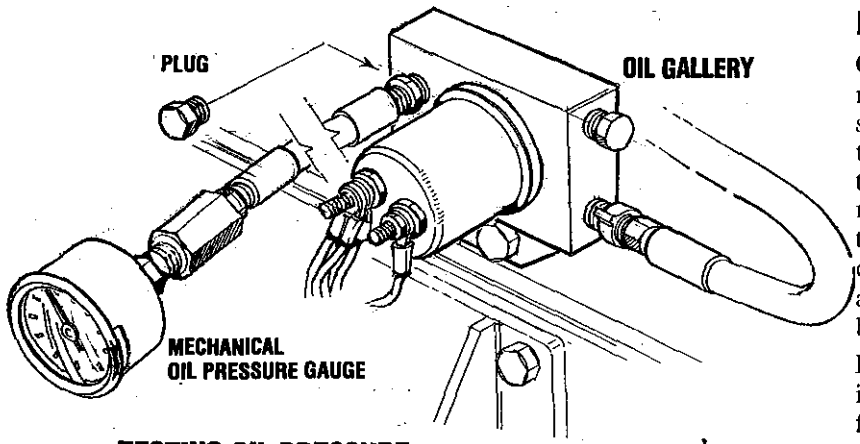
⚠ WARNING: ***Do not keep a glow plug on for more than 30 seconds.***

GLOW PLUG TIGHTENING TORQUE
1.0 - 1.5 M-KG (7 -11 FT-LB)



ENGINE ADJUSTMENTS

NOTE: *WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.*



TESTING OIL PRESSURE

To test the oil pressure, remove the oil pressure sender, then install a mechanical oil pressure gauge in it's place. After warming up the engine, set the engine speed at idle and read the oil pressure gauge.

OIL PRESSURE WILL RANGE BETWEEN 50 AND 55PSI AT 1800 RPM

LOW OIL PRESSURE

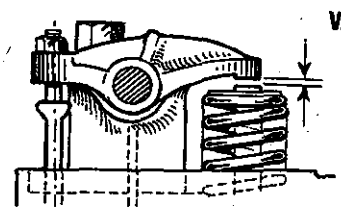
The specific safe minimum oil pressure is 5 - 10 psi. A gradual loss of oil pressure usually indicates worn bearings. For additional information on low oil pressure readings, see the *ENGINE TROUBLESHOOTING* chart.

VALVE ADJUSTMENT

Remove the glow plugs from the cylinder so the engine can be easily manually rotated. Remove the valve train rocker cover. Rotate the engine crank manually and observe the valve operation for cylinder **#1** and bring the **#1** piston up to Top Dead Center of the compression stroke. Adjust the valves referencing the chart below. Rotate the crankshaft 360°. This should put the valves for cylinder **#1** in the overlap position. Adjust the remaining valves following the chart below.

VALVE CLEARANCE (ENGINE COLD) 0.23 - 0.27mm (0.0091 - 0.0106 in)

		IN	EX	IN	EX	IN	EX
When No.1 piston is compressed Top Dead Center	1st	○	○	○	○	○	○
	2nd		○		○	○	
	3rd			○			○
	4th						
When No.1 piston is in overlap position	1st						
	2nd	○		○			○
	3rd				○	○	
	4th					○	○



VALVE CLEARANCE

(ENGINE COLD)
0.23 - 0.27mm
(0.0091 - 0.0106 in)

ENGINE COMPRESSION

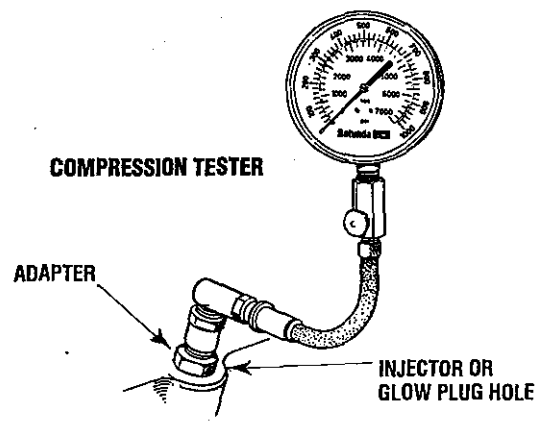
Check the compression pressure. To do this warm the engine, remove all fuel injectors, or glow plugs, disconnect the fuel shut-off solenoid wire, and install a compression adapter in the injector hole or glow plug hole. Connect a compression tester on the adapter and crank the engine with the starter motor until the pressure reaches a maximum value. Repeat this process for each cylinder. Look for cylinders with dramatically (at least 20%) lower compression than the average of the others. Compression pressure should not differ by more than 35.5 psi (2.5 kg/cm²) at 280 rpm.

If a weak cylinder is flanked by healthy cylinder, the problem is either valve or piston related. Check the valve clearances for the weak cylinder, adjust as needed and test again. If the cylinder is still low, apply a small amount of oil into the cylinder to seal the rings and repeat the test. If compression comes up - the rings are faulty.

Abnormally high readings on all cylinders indicates heavy carbon accumulations, a condition that might be accompanied by high pressures and noise.

NOTE: *In case of severe vibrations and detonation noise, the cause may be fuel injector problems, see* FUEL INJECTORS. *Poor fuel quality, contaminates and loss of positive fuel pressure to the injection pump will result in injector faults.*

When re-installing the glow plugs use anti-seize compound.



TESTING ENGINE COMPRESSION

ENGINE ADJUSTMENTS

DRIVE BELT ADJUSTMENT

For your safety, WESTERBEKE generator models come equipped with belt guards that cover over the belt(s) on the front of the engine. ("Out of sight - out of mind." The belt guard is NOT installed for that purpose.) Operators are advised that proper inspection, service, and maintenance is required.

The drive belt must be properly tensioned. Excessive drive belt tension can cause rapid wear of the belt and reduce the service life of the fresh water pump's bearing. A slack belt or the presence of oil on the belt can cause belt slipping, resulting in high operating temperatures.

The generator have two drive belts, one drives the governor and alternator and the other drives the raw water pump. The tension adjustment procedure for both belts is as follows:

1. Remove the belt guard.
2. Loosen the alternator adjusting strap bolt and the base mounting bolt.
3. With the belt loose, inspect for wear, cracks and frayed edges.
4. Pivot the alternator on the base mounting bolt to the left or right as required, to loosen or tighten.
5. The drive belts are properly adjusted if it can be deflected no less than 3/8 inch (10mm) and no more than 1/2 inch (12mm) as the belt is depressed with the thumb at the midpoint between the two pulleys on the longest span of the belt.

> **⚠ WARNING:** ***Never attempt to check or adjust a drive belt's tension while the engine is in operation.***

6. Operate the generator for about 5 minutes, then shut down the generator and recheck the belts) tension.
7. Replace the belt guard.

FUEL INJECTORS

NOTE: *WESTERBEKE recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.*

REMOVING THE INJECTORS

NOTE: *Injector must be serviced in a "clean room" environment.*

1. Disconnect the high pressure lines from the injectors and loosen the lines at their attachment to the injection pump and move them out of the way of the injectors. Avoid bending the lines.
2. Using a 17mm long socket, remove the fuel return line in its entirety from the top of the injectors. Take care not to lose the two sealing washers and banjo bolt that attaches the fuel return line to each injector.

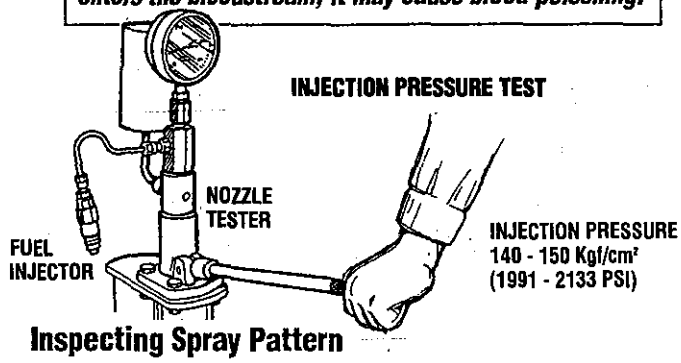
NOTE: *Clean the area around the base of the injector prior to lifting it out of the cylinder head to help prevent any rust or debris from falling down into the injector hole. If the injector will not lift out easily and is held in by carbon build up or the like, work the injector side to side with the aid of the 17mm deep socket wrench to free it and then lift it out.*

3. The injector seats in the cylinder head on a copper sealing washer. This washer should be removed with the injector and replaced with a new washer when the injector is reinstalled.

INJECTION TESTING

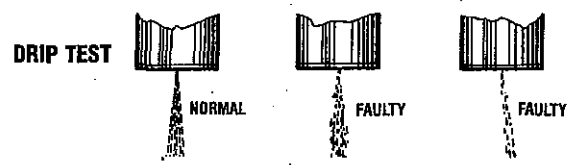
1. Using the nozzle tester, check the spray pattern and injection starting pressure of nozzle and, if it exceeds the limit, adjust or replace the nozzle. When using nozzle tester, take the following precautions:

> **⚠ CAUTION:** ***The spray injected from the nozzle is of such velocity that it may penetrate deeply into the skin of fingers and hands, destroying tissue. If it enters the bloodstream, it may cause blood poisoning.***

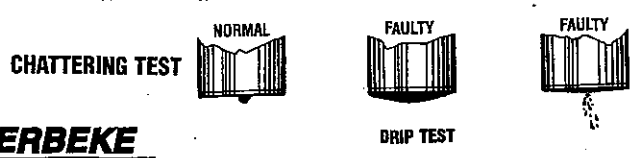


Inspecting Spray Pattern

1. Operate the hand lever of the nozzle tester at intervals of one stroke per second to check if the fuel is injected correctly in its axial direction. A nozzle is defective if it injects fuel in an oblique direction or in several separate strips. Also, a spray in the form of particles indicates a defect. These defects may sometimes be caused by clogging with dust and, therefore, all parts should be carefully cleaned before reassembly.



2. Apply the pressure of 1635 lb/in² (115 kg/cm²) to nozzle by operating the hand lever, and check the drips from the nozzle tip. If it drips or has a large accumulation of fuel on the bottom, it is considered defective and should be replaced. A very small amount of fuel may sometimes remain on the tip of the nozzle; however, this does not indicate a defect.



TESTING THE MAGNETIC PICK UP COIL

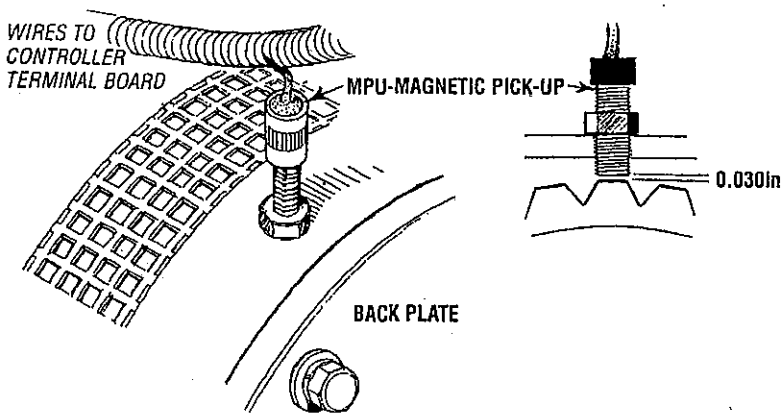
Test the speed sensor connector for voltage and resistance values.

If the values are correct, remove and inspect the magnetic pick up. With the wires disconnected, unscrew the magnetic pick up from the generator housing and visually inspect the contact end. If any damage is detected, replace the unit.

NOTE: *Carefully follow the installation instructions provided with the new magnetic pick up coil.*

SPEED SENSOR TEST VALUES
VOLTAGE (while cranking)
1.5 - 2.5 VAC

RESISTANCE (at rest) **950 - 1000 ohm**



MAGNETIC PICK-UP [MPU] INSTALLATION

The MPU is installed in the threaded opening on the side of the flywheel bellhousing. This positions the MPU over the teeth of the flywheel ring gear.
Viewing through this opening, manually rotate the engine crankshaft so as to position the flat of one of the ring gear's teeth directly under the opening. Thread the MPU into the opening until it gently contacts the flat of this tooth (Thread is 3/8" x 24). Back the MPU out of the opening one turn and then lock it in this position with the jam nut. This will position the end of the MPU approximately 0.030 inches away from the flats of the ring gear teeth.

To ensure the MPU is positioned correctly, slowly rotate the crankshaft by 360° by hand to assure there is no physical contact between the MPU and the ring gear teeth.

If contact is felt between the MPU and the flywheel teeth, the MPU may be damaged. Remove the MPU and inspect it. Replace if necessary and repeat the above installation procedure.

NOTE: *When replacing the Magnetic Pick-Up (MPU) it **MUST** be replaced without cutting and splicing into the existing wiring cable. Doing so will cause a erratic AC signal to the controller.*

SPECIFICATIONS
25.5/23.5KW, 28.5/23.5KW, 33.0.26.0KW EDE

ENGINE SPECIFICATIONS

Engine Type	Diesel, four-cycle, four-cylinder, fresh water-cooled, vertical in-line overhead valve mechanism.
Aspiration	Naturally aspirated
Compression Ratio	21.8:1
Governor	Electronic
Combustion Chamber	Swirl type
Bore & Stroke	98 x 110 mms (3.86 x 4.93 iinches)
Piston Displacement	3.31 liters (202.53 cubic inches)
Hp @1800rpm	55
Hp @ 1500rpm	48
Firing Order	1 - 3 - 4 - 2
Inclination	Continuous 20° Temporary 30° (not to exceed 10 min.)
Weight (dry)	1135 lbs (514.8 kgs)

TUNE-UP SPECIFICATIONS

Compression Pressure (allowable limit)	626 psi (44 kgf/cm²) at 250 rpm 472 psi (30.5 kgf/cm²) at 250 rpm
Variation between cylinders	10% or less
Injection Timing	7° BTDC
Engine Speed	1800 rpm 60 Hertz 1500 rpm 50 Hertz
Valve Clearance (engine cold)	0.23 to 0.27 mm (0.00091 to 0.0106 inches)
Injector Pressure	1991 to 2134 psi (140 to 150 kgf/cm²)
Valve Timing	Intake Opens 14° BTDC Intake Closes 36° ABDC Exhaust Opens 45° BBDC Exhaust Closes 17° ATDC

ELECTRICAL SYSTEM

Starting Battery	12-Volt DC (-) negative ground
Battery Capacity	800-1000 CCA
DC Charging Alternator	60 Amp rated, belt-driven
Starter	2.5Kw, 12VDC direct drive
Starting Aid	Glow plugs, sheathed type
DC Cranking Current	400 - 600 (includes glow plugs)

COOLING SYSTEM

General	Fresh water-cooled engine block, thermostatically-controlled with heat exchanger.
Operating Temperature	160 - 180° F (71 - 82° C)
Fresh Water Pump	Centrifugal type, metal impeller, belt-driven
Raw Water Pump	Positive displacement, rubber impeller, gear-driven.
System Capacity (fresh water)	16 qts (15.1 liters)
Raw Water Flow Rate (at 1800 rpm)	11.0 gpm (41.6 lpm)

FUEL SYSTEM

General	Open flow, self bleeding, self priming (electromagnetic fuel pump)
Fuel	No. 2 diesel (cetane rating of 45 or higher)
Fuel Injection Pump	Bosch type mini-pump
Fuel Injection Timing	7° BTDC (spill)
Injector Nozzle	Bosch throttle type
Fuel Filter	Spin-on type
Air Intake	Metal screen/intake silencer box
Air Flow Combustion	105 cfm (3.0 cmm)

LUBRICATION SYSTEM

General	Pressure fed system with external relief valve
Oil Filter	Full flow, paper element, spin-on type
Sump Capacity (includes oil filter)	14.0 U.S. qts (13.2 liters)
Operating Oil Pressure (engine hot)	28 - 57 psi (2.0 - 4.0 kg/cm²)
Oil Grade	API Specification CF, CG-4, CF-4 or CH-4 SAE 10W-30, 15W-40

GENERATOR COOLING

Air Requirements (generator cooling)	0.8 Power factor unit. 500 CFM (15.0 CMM)

NOTE: *Increase cooling air flow 15% for slower turning 50hz units.*

Generator Compartment Ambient Temperature	122° F (50° C) maximum

SPECIFICATIONS 25.5/21.0KW EDE

AC GENERATOR (Single Phase)

Single Phase	Brushless, six- pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable (Double Delta for 120/240 volts, 60hz.) (Series Star for 230 volts, 50hz) With solid state voltage regulator.	
Voltage	120 or 120/240 volts - 60 hertz 230 Volts - 50 Hertz	
Voltage Regulation	±2% no load to full load.	
Frequency Regulation	.3 Hertz (.5%) no load to full load.	
Rating (Volts AC)		
60 Hz (1800 rpm)	120 volts	212.5 amps
12.5 KW	120/240 volts	212.5/106.3 amps
50 Hz (1500 rpm)	230 volts	91.3 amps
9.3 KW		
Generator Cooling Air requirements (Single & 3 phase)	400 cfm (11.3 cmm)	
	NOTE: *Increase air supply 15% for 50 Hertz operation (1500 rpm)*	
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum	
	NOTE: *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*	

AC GENERATOR (3 Phase)

Three Phase	Brushless, six-pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable. Solid state voltage regulator.	
Voltage - 3 phase (60 Hertz)	Low Voltage WYE	240 Volts
	High Voltage WYE	480 Volts
	DELTA	277 Volts
Voltage - 3 Phase (50 Hertz)	High Voltage WYE	400 Volts
	DELTA	230 Volts
Amperage - 3 phase (60 Hertz)	Low Voltage WYE	76 Amps
	High Voltage WYE	38 Amps
	DELTA	66.5 Amps
Amperage - 3 phase (50 Hertz)	High Voltage WYE	37.9 Amps
	DELTA	65.9 Amps
Generator Cooling Air requirements (60 Hz) at 1800 rpm	225 - 250 cfm (5.66 - 6.37 cmm)	
	NOTE: *Increase air supply 15% for 50 Hertz operation (1500 rpm)*	
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum	
	NOTE: *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*	

SPECIFICATIONS 28.5/23.5KW EDE

AC GENERATOR (Single Phase)

Single Phase	Brushless, six- pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable (Double Delta for 120/240 volts, 60hz.) (Series Star for 230 volts, 50hz) With solid state voltage regulator.	
Voltage	120 or 120/240 volts - 60 hertz 230 Volts - 50 Hertz	
Voltage Regulation	±2% no load to full load.	
Frequency Regulation	.3 Hertz (.5%) no load to full load.	
Rating (Volts AC)		
60 Hz (1800 rpm)	120 volts	237.5 amps
	120/240 volts	237.5/118.8 amps
50 Hz (1500 rpm)	230 volts	102.2 amps
Generator Cooling Air requirements (Single & 3 phase)	400 cfm (11.3 cmm)	
	NOTE: *Increase air supply 15% for 50 Hertz operation (1500 rpm)*	
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum	
	NOTE: *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*	

AC GENERATOR (3 Phase)

Three Phase	Brushless, six-pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable. Solid state voltage regulator.	
Voltage - 3 phase (60 Hertz)	Low Voltage WYE	240 Volts
	High Voltage WYE	480 Volts
	DELTA	277 Volts
Voltage - 3 Phase (50 Hertz)	High Voltage WYE	400 Volts
	DELTA	230 Volts
Amperage - 3 phase (60 Hertz)	Low Voltage WYE	85.8 Amps
	High Voltage WYE	42.9 Amps
	DELTA	74.3 Amps
Amperage - 3 phase (50 Hertz)	High Voltage WYE	42.4 Amps
	DELTA	73.8 Amps
Generator Cooling Air requirements (60 Hz) at 1800 rpm	225 - 250 cfm (5.66 - 6.37 cmm)	
	NOTE: *Increase air supply 15% for 50 Hertz operation (1500 rpm)*	
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum	
	NOTE: *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*	

SPECIFICATIONS 33.0/26.0KW EDE

AC GENERATOR (Single Phase)

Single Phase	Brushless, six- pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable (Double Delta for 120/240 volts, 60hz.) (Series Star for 230 volts, 50hz) With solid state voltage regulator.	
Voltage	120 or 120/240 volts - 60 hertz 230 Volts - 50 Hertz	
Voltage Regulation	±2% no load to full load.	
Frequency Regulation	.3 Hertz (.5%) no load to full load.	
Rating (Volts AC)		
60 Hz (1800 rpm)	120 volts 120/240 volts	275 amps 275/137.5 amps
50 Hz (1500 rpm)	230 volts	113 amps
Generator Cooling Air requirements (Single & 3 phase)	500 cfm (14.1 cmm) **NOTE:** *Increase air supply 15% for 50 Hertz operation (1500 rpm)*	
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*	

AC GENERATOR (3 Phase)

Three Phase	Brushless, six-pole, revolving field. Sealed lubricated, single-bearing design. 12 Lead reconnectable. Solid state voltage regulator.	
Voltage - 3 phase (60 Hertz)	Low Voltage WYE High Voltage WYE DELTA	240 Volts 480 Volts 277 Volts
Voltage - 3 Phase (50 Hertz)	High Voltage WYE DELTA	400 Volts 230 Volts
Amperage - 3 phase (60 Hertz)	Low Voltage WYE High Voltage WYE DELTA	99.3 Amps 49.6 Amps 86.0 Amps
Amperage - 3 phase (50 Hertz)	High Voltage WYE DELTA	46.9 Amps 81.6 Amps
Generator Cooling Air requirements (60 Hz) at 1800 rpm	225 - 250 cfm (5.66 - 6.37 cmm) **NOTE:** *Increase air supply 15% for 50 Hertz operation (1500 rpm)*	
Generator Compartment Ambient Temperature Recommendations	122°F (50°C) maximum **NOTE:** *Forced ventilation should be provided to maintain generator compartment temperatures below 104°F (40°C).*	

USE OF ELECTRIC MOTORS

The power required to start an electric motor is considerably more than is required to keep it running after it is started. Some motors require much more current to start them than others. Split-phase (AC) motors require more current to start, under similar circumstances, than other types. They are commonly used on easy-starting loads, such as washing machines, or where loads are applied after the motor is started, such as small power tools. Because they require 5 to 7 times as much current to start as to run, their use should be avoided, whenever possible, if the electric motor is to be driven by a small generator. Capacitor and repulsion-induction motors require from 2 to 4 times as much current to start as to run. The current required to start any motor varies with the load connected to it. An electric motor connected to an air compressor, for example, will require more current than a motor to which no load is connected.

In general, the current required to start 115-Volt motors connected to medium starting loads will be approximately as follows:

MOTOR SIZE (HP)	AMPS FOR RUNNING (AMPERES)	AMPS FOR STARTING (AMPERES)
1/6	3.2	6.4 to 22.4*
1/4	4.6	9.2 to 32.2*
1/3	5.2	10.4 to 72.8*
1/2	7.2	14.4 to 29.2*
3/4	10.2	20.4 to 40.8*
1	13	26 to 52

***NOTE:** *In the above table the maximum* Amps for Starting *is more for some small motors than for larger ones. The reason for this is that the hardest starting types (split-phase) are not made in larger sizes.*

Because the heavy surge of current needed for starting motors is required for only an instant, the generator will not be damaged if it can bring the motor up to speed in a few seconds. If difficulty is experienced in starting motors, turn off all other electrical loads and, if possible, reduce the load on the electric motor.

Required Operating Speed

Run the generator first with no load applied, then at half the generator's capacity, and finally loaded to its full capacity as indicted on the generator's data plate. The output voltage should be checked periodically to ensure proper operation of the generating plant and the appliances it supplies. If an AC voltmeter or ampmeter is not installed to monitor voltage and load, check it with a portable meter and amp probe.

Generator Frequency Adjustment

Frequency is a direct result of engine/generator speed, as indicated by the following:

- ☐ When the generator is run at 1800 RPM, the AC voltage output frequency is 60 Hertz.

Therefore, to change the generator's frequency, the generator's drive engine's speed must be changed .along with a reconfiguring of the AC output connections at the generator.

Generator Maintenance

- ☐ Maintaining reasonable cleanliness is important. Connections of terminal boards and rectifiers may become corroded, and insulation surfaces may start conducting if salts, dust, engine exhaust, carbon, etc. are allowed to build up. Clogged ventilation openings may cause excessive heating and reduced life of windings.
- ☐ For unusually severe conditions, thin rust-inhibiting petroleum-base coatings, should be sprayed or brushed over all surfaces to reduce rusting and corrosion.
- ☐ In addition to periodic cleaning, the generator should be inspected for tightness of all connections, evidence of overheated terminals and loose or damaged wires.
- ☐ The drive discs on single bearing generators should be checked periodically if possible for tightness of screws and for any evidence of incipient cracking failure. Discs should not be allowed to become rusty because rust may accelerate cracking. The bolts which fasten the drive disc to the generator shaft must be hardened steel SAE grade 8, identified by 6 radial marks, one at each of the 6 corners of the head.
- ☐ The rear armature bearing is lubricated and sealed; no maintenance is required. However, if the bearing becomes noisy or rough-sounding, have it replaced.
- ☐ Examine bearing at periodic intervals. No side movement of shaft should be detected when force is applied. If side motion is detectable, inspect the bearing and shaft for wear. Repair must be made quickly or major components will rub and cause major damage to generator.

Carbon Monoxide Detector

WESTERBEKE recommends mounting a carbon monoxide detector in the vesssel's living quarters. **Carbon Monoxide, even in small amounts, is deadly.**

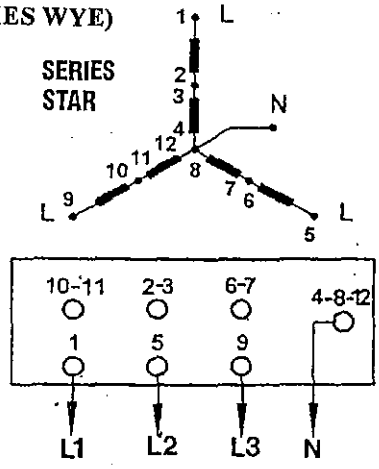
The presence of carbon monoxide indicates an exhaust leak from the engine or generator or from the exhaust elbow/ exhaust hose, or that fumes from a nearby vessel are entering your boat.

If carbon monoxide is present, ventilate the area with clean air and correct the problem immediately!

TWELVE LEAD WINDING/TERMINAL BOARD CONNECTIONS
AND (NOMINAL) VOLTAGES

(SERIES WYE)

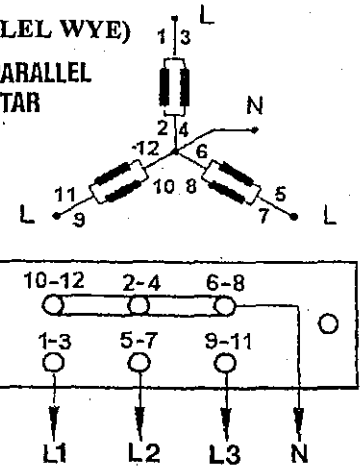
SERIES STAR



50 Hz L-L 400 volts
50 Hz L-N 230 volts
60 Hz L-L 480 volts
60 Hz L-N 277 volts

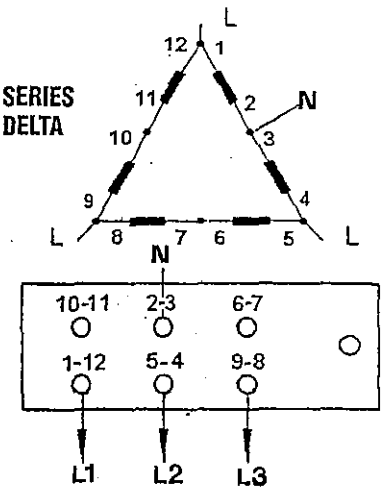
(PARALLEL WYE)

PARALLEL STAR



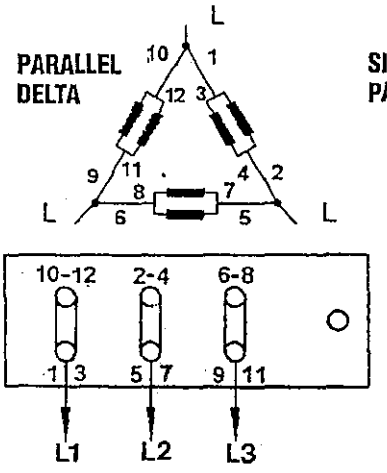
50 Hz L-L 200 volts
50 Hz L-N 115 volts
60 Hz L-L 240 volts
60 Hz L-N 138 volts

SERIES DELTA



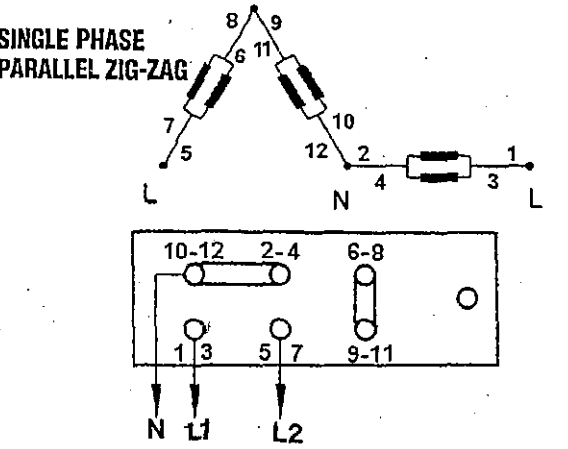
50 Hz L-L 230 volts
50 Hz L-N 115 volts
60 Hz L-L 277 volts
60 Hz L-N 138 volts
(Refer to Note #1)

PARALLEL DELTA



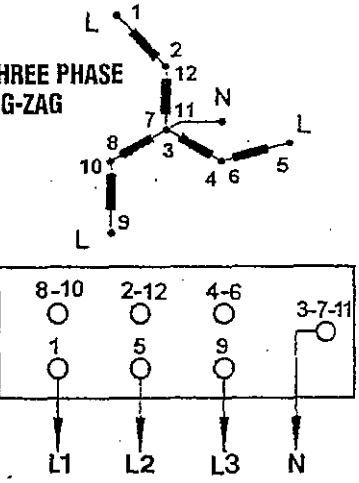
50 Hz L-L 115 volts
60 Hz L-L 138 volts

SINGLE PHASE PARALLEL ZIG-ZAG



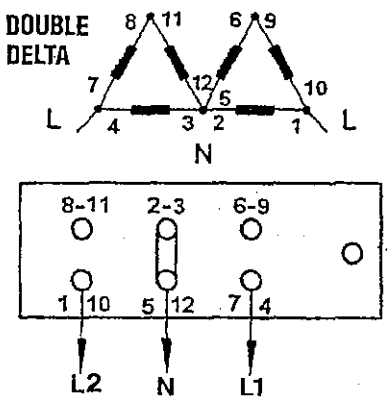
50 Hz L-L 230 volts
50 Hz L-N 115 volts
60 Hz L-L 277 volts
60 Hz L-N 138 volts
(Refer to Note #1)

THREE PHASE ZIG-ZAG



50 Hz L-L 346 volts
50 Hz L-N 200 volts
60 Hz L-L 415 volts
60 Hz L-N 240 volts
(Refer to Note #2)

DOUBLE DELTA

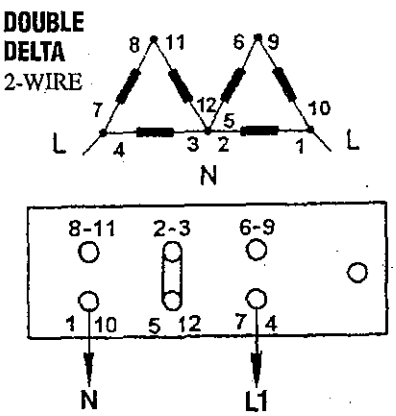


50 Hz L-L 230 volts
50 Hz L-N 115 volts
60 Hz L-L 240 volts
60 Hz L-N 120 volts

Note #1 *Single phase amperage load. The phase current must not exceed the nominal value.*

Note #2 *Three phase zig-zag connection. The rated power must be multiplied by 0.866.*

DOUBLE DELTA 2-WIRE



50 Hz L-N 230 volts
60 Hz L-N 240 volts

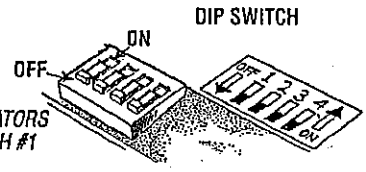
CHANGING HERTZ AND VOLTAGE

> **⚠ CAUTION:** ***As a precaution against an unintentional start, shut off the 20 Amp DC breaker on the control panel.***

1. Refer to the previous page that illustrates the various AC voltage output configurations for both the 60 Hertz and 50 Hertz applications. Select the configuration for the Hertz/Voltage required.
2. Reconfigure the 12 AC connections on the terminal board carefully following the illustration. Reference below the voltage sensing diagram and it;s connections to the AC terminal block. There are three line connections when needed and a neutral. These connections **MUST** correspond to and be connected to the line (L) connections on the AC terminal board and the neutral connection as well to it's corresponding connection. Failure to properly connect these voltage sense connections can result in an AC output voltage fault shut down either from low or high AC voltage or incorrect AC voltage displayed on the LCD display.

NOTE: *When reconfiguring the AC output, ensure that the AVR Neutral and line connections are properly connected to the AC terminal block.*

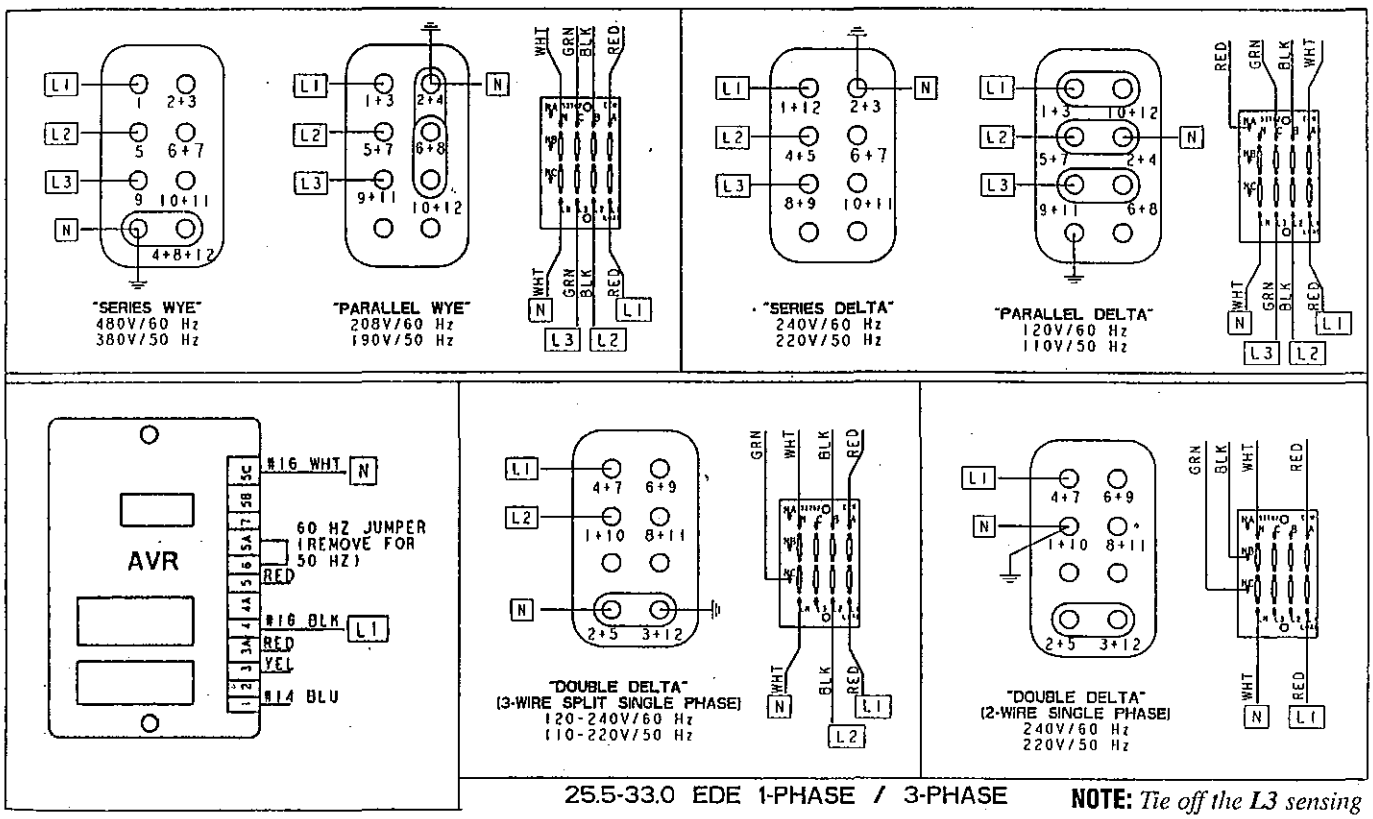
3. There are three line connections. When an L3 is not present on the AC terminal block, insulate and tie off the L3 connection from the Voltage Sensing Board.
4. Inside the control box, locate the ECU and position the Hertz/Frequency dip switch in the correct position for the Hertz/Frequency desired.
5. Verify all connections are correct and turn off any AC panel breakers.
6. Start the generator and monitor the AC output voltage at the generator's terminal board. Line to line, line to neutral. Adjust the voltage regulator board as needed to obtain the correct voltage. Check the generator hertz/frequency with your hertz meter.
7. Turn on the AC panel breakers and load unit and monitor the operation.



WHEN CHANGING THE GENERATORS FREQUENCY (50/60 HZ) SWITCH #1 ON THE CONTROL PANEL ECU BOARD MUST BE SWITCHED: ON FOR 50 HZ AND OFF FOR 60 HZ.

AC OUTPUT CONFIGURATIONS

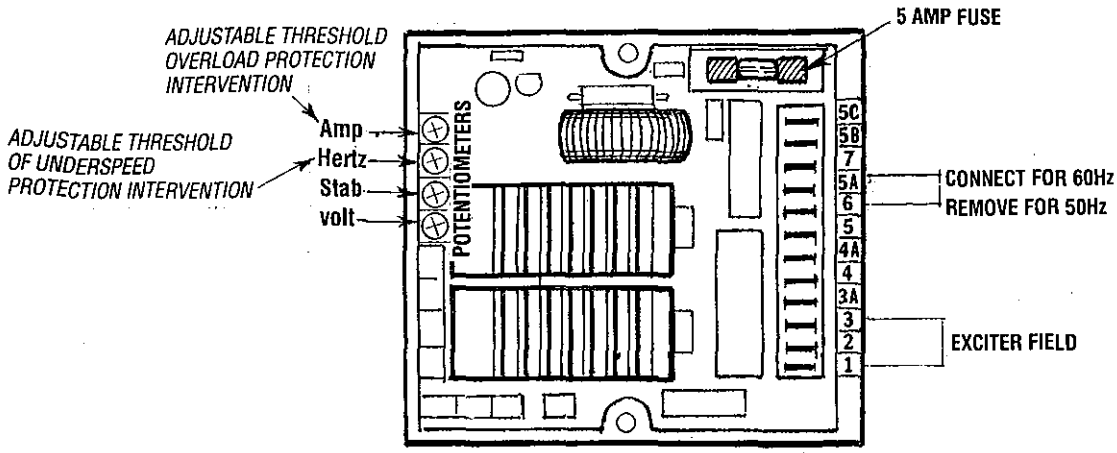
VOLTAGE SENSING BOARD CONNECTIONS



25.5-33.0 EDE 1-PHASE / 3-PHASE

NOTE: *Tie off the L3 sensing connection when not in use.*

ELECTRONIC REGULATION SR7-2G AVR



DESCRIPTION

The voltage regulator (AVR) ensures optimum AC generator performance. This advanced design AVR is equipped with circuitry protection to guard against operating conditions that could be detrimental to the AC generator. The following information details the voltage regulators adjustments and connections. These procedures should be performed by a qualified technician.

TERMINAL CONNECTIONS

#1. Excitation field DC negative.

#2. Exciter field jumper to **3** if the regulator AC supply between **5** and **3A** is less than 160 VAC.

#3. Exciter field DC positive.

#3A. Supply voltage to regulator (AC).

#4. Sensing voltage.

#5. Supply voltage to regulator (AC).

#6. Jumper to **5A** for 60 Hz operation.

#7. Not used.

#5B. Not used.

#5C. Sensing voltage.

POSSIBLE CONNECTIONS

Exciter Field: The exciter field negative should be connected to terminal **1** of the electronic regulator (normally dark blue or black), while the positive (normally red or yellow) should be connected to terminal **3**.

Supply: There are two possibilities.

1. The supply coincides with the sensing. In this case the SR7/2 supply should be connected to terminals **3** and **5** (in case of three-phase generators, terminal **5** is normally connected with the star point). Terminals **3** and **4** should be connected to each other in such a way that the supply is also sensing. This connection in necessary when the generator does not have auxiliary winding for supplying the regulator.
2. The supply and sensing separate. This is the case of a generator equipped with auxiliary winding for regulator supply. Supply is always connected to terminals **3** and **5** of the regulator.

In both of these cases, the SR7/2 supply can vary from 80 to 270 VAC. But it should be noted that terminals 2 and 3 should be bridged for supply with voltage between 80 and 160 VAC, while the same terminals should be left open if the voltage is between 160 and 270 VAC.

Sensing: Sensing should be connected to terminals **4** and **5** and can vary from 80 to 350 VAC. The sensing is single phase only and therefore is normally connected to one alternator phase.

Operation at 60 Hz: When operating at 60 Hz, terminals **5A** and **6** should be connected to each other in order to keep the low frequency protection correctly regulated.

> ⚠ **WARNING:** ***Be aware that high voltages may be present. Take all necessary precautionms to safe guard against electrical hazards.***

FUNCTIONS OF THE REGULATOR POTENTIOMETERS

Volt: With this potentiometer, it is possible to adjust the voltage generated by the alternator in a very simple way. If the screw is turned clockwise, the voltage increases, if the screw is turned counterclockwise it decreases.

Stab: This potentiometer optimizes alternator performance. If turned clockwise, the stability decreases and the response time decreases but the voltage tends to be less stable. If turned counterclockwise, the response time increases and the voltage tends to be more stable.

In order to adjust this potentiometer correctly, we advise using the following method.

1. The generator must be working, starting from zero load and the potentiometer must be at maximum stability (turned fully counterclockwise).
2. Slightly turn clockwise until the light generated by the filament lamp oscillates, at this point, turn the potentiometer slowly counterclockwise until the light stabilizes.

ELECTRONIC REGULATION SR7-2G AVR

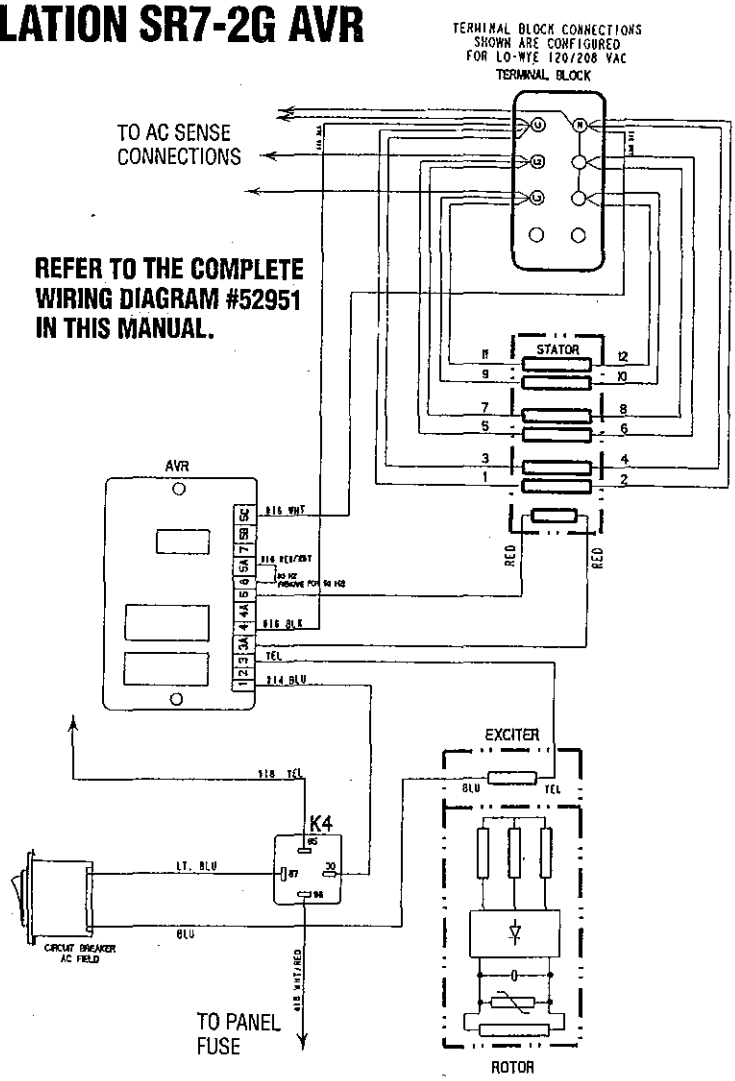
Hertz: With this potentiometer, which is normally pre-calibrated then sealed by the manufacturer, it is possible to adjust the low frequency protection intervention. To recalibrate this protection, you must take the generator to a normal zero load condition, turn the potentiometer clockwise until the limit position is reached, then decrease the nominal speed by 10 %. Then turn the potentiometer counterclockwise and measure the voltage value until it has decreased by 5 volts.

When the speed decreases by more than 10% of the nominal value, the voltage also decreases proportionally, blocking generator overheating. Even if we advise calibrating this protection at 10% of the nominal value, it is obviously possible to calibrate the threshold at other values.

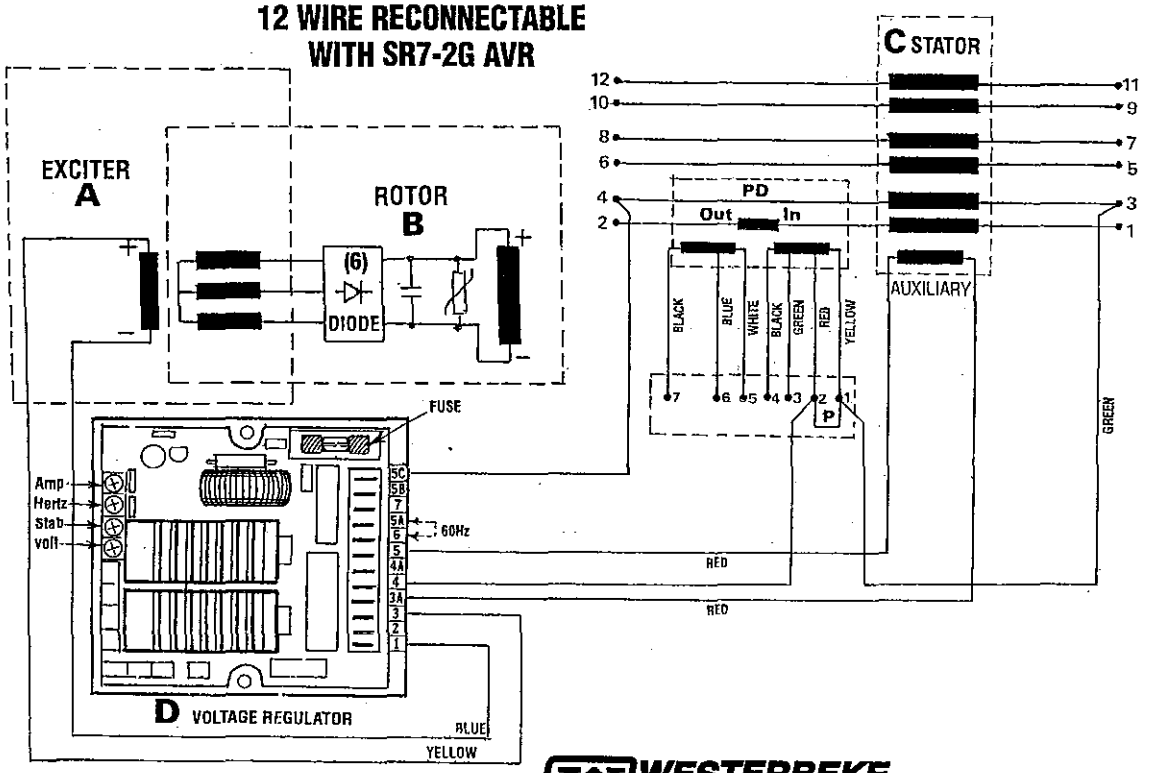
Amp: With this potentiometer, it is possible to adjust the intervention level of the overload protection. This protection system has an intervention delay, which permits a temporary overload, necessary when starting motors or similar applications.

To modify this protection, you must overload the generator by 15% of the normal load, turn the potentiometer to minimum (counterclockwise) and wait about twenty seconds. During this period of time the voltage value decreases. In this condition and while turning the potentiometer clockwise, fix the generator voltage value at 10% less than the nominal one. At this point, while the initial overload is being removed, the voltage increases to the nominal value.

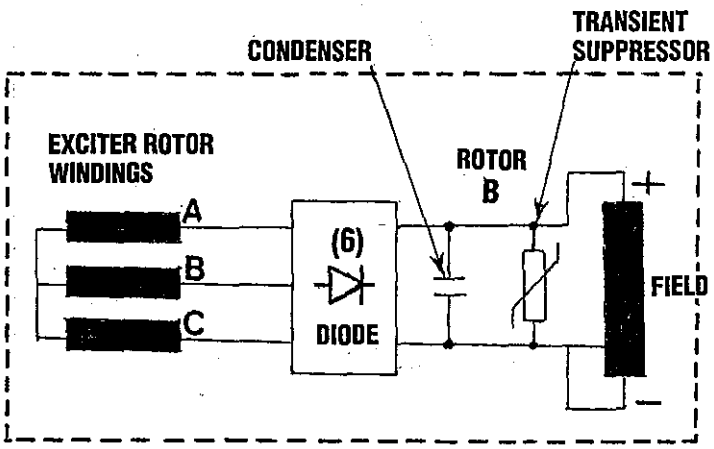
Fuse: The electronic regulator is equipped with a fuse, which protects the alternator from overheating in cases of regulator malfunction. The fuse (250V-5A, quick acting, F type) can be replaced easily.

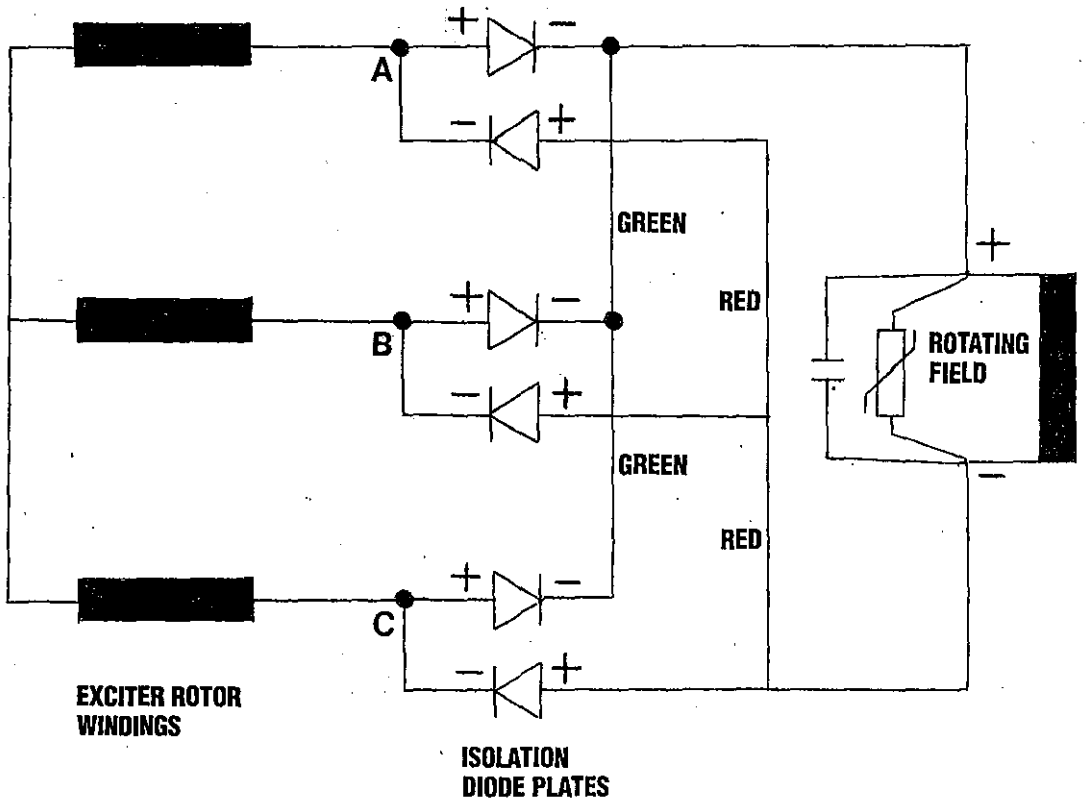


INTERNAL WIRING DIAGRAM 12 WIRE RECONNECTABLE WITH SR7-2G AVR



INTERNAL WIRING SCHEMATIC
EXCITER ROTOR/ROTATING FIELD





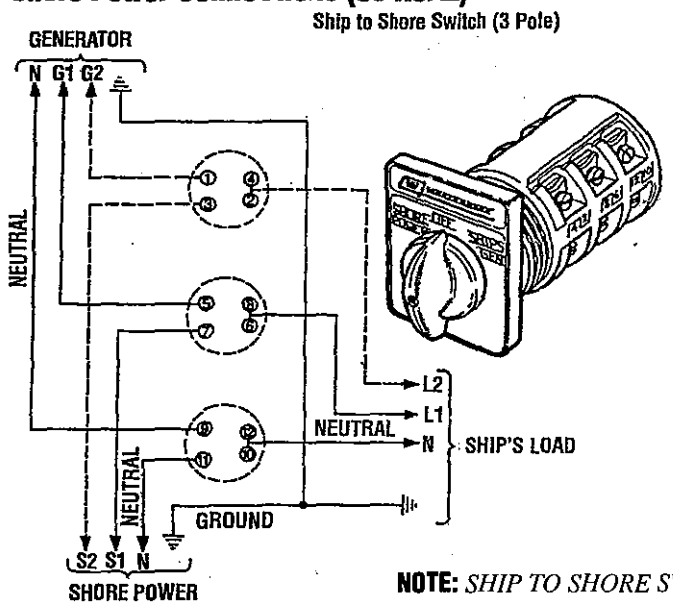
SHORE POWER TRANSFER SWITCH

If the installer connects shore power to the vessel's AC circuit, this must be done by means of the SHORE POWER/ OFF/SHIPS GEN. Set the transfer switch shown in the diagrams to the OFF position. This switch prevents simultaneous connection of shore power to generator output.

> ⚠ **CAUTION:** ***Damage to the generator can result if utility shore power and generator output are connected at the same time. This type of generator damage is not covered under the warranty; it is the installer's responsibility to make sure all AC connections are correct.***

> ⚠ **CAUTION:** ***Heavy motor leads should be shut off before switching shore power to generator power or vice-versa because voltage surges induced by switching with heavy AC loads on the vessel being operated may cause damage to the exciter circuit components in the generator.***

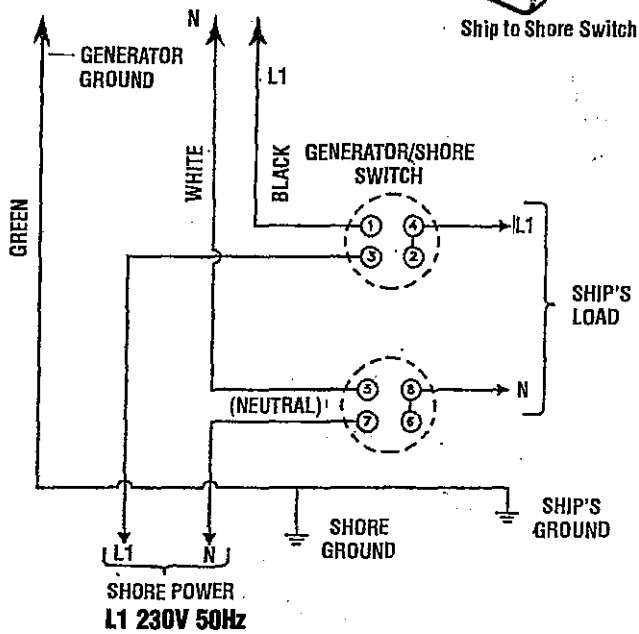
Shore Power Connections (60 Hertz)



NOTE: *Diagram shows connections for a two-wire, 120 volt system. For a three-wire system, use the dotted lines for the other hot leg.*

230 Volt/50 Hertz Two Wire Configuration

Notice the repositioning of the white ground lead on the terminal block to the generator case.



SHORE POWER TRANSFER SWITCH AND CONNECTION SHOWN ARE FOR SINGLE PHASE ONLY

NOTE: *SHIP TO SHORE SWITCHES ARE AVAILABLE AT YOUR WESTERBEKE DEALER.*

LAY-UP & RECOMMISSIONING

GENERAL

Many owners rely on their boatyards to prepare their craft, including engines and generators, for lay-up during the off-season or for long periods of inactivity. Others prefer to accomplish lay-up preparation themselves.

The procedures which follow will allow you to perform your own lay-up and recommissioning, or you may use them as a check list if others do the procedures.

These procedures should afford your engine protection during a lay-up and also help familiarize you with the maintenance needs of your engine.

If you have any questions regarding lay-up procedures, call your local servicing dealer; he will be more than willing to provide assistance.

Propeller Shaft Coupling *[Propulsion Engine]*

The transmission and propeller half couplings should always be opened up and the bolts removed when the boat is hauled out of the water or moved from land to water, and during storage in the cradle. The flexibility of the boat often puts a severe strain on the propeller shaft or coupling or both, while the boat is taken out or put in the water. In some cases, the shaft has actually been bent by these strains. This does not apply to small boats that are hauled out of the water when not in use, unless they have been dry for a considerable period of time.

Fresh Water Cooling Circuit *[Propulsion Engine]*

A 50-50 solution of antifreeze and distilled water is recommended for use in the coolant system at all times. This solution may require a higher concentration of antifreeze, depending on the area's winter climate. Check the solution to make sure the antifreeze protection is adequate.

Should more antifreeze be needed, drain an appropriate amount from the engine block and add a more concentrated mixture. Operate the engine to ensure a complete circulation and mixture of the antifreeze concentration throughout the cooling system. Now recheck the antifreeze solution's strength.

Lubrication System

With the engine warm, drain all the engine oil from the oil sump. Remove and replace the oil filter and fill the sump with new oil. Use the correct grade of oil. Refer to the *ENGINE LUBRICATING OIL* pages in this manual for the oil changing procedure. Run the engine and check for proper oil pressure and make sure there are no leaks.

> ⚠ **CAUTION:** ***Do not leave the engine's old engine oil in the sump over the lay-up period. Lubricating oil and combustion deposits combine to produce harmful chemicals which can reduce the life of your engine's internal parts.***

Fuel System *[Gasoline]*

Top off your fuel tanks with *unleaded* gasoline of 89 octane or higher. A fuel conditioner such as *Sta-Bil* gasoline stabilizer should be added. Change the element in your gasoline/water separator and clean the metal bowl. Re-install and make certain there are no leaks. Clean up any spilled fuel.

Fuel System *[Diesel]*

Top off your fuel tanks with No. 2 diesel fuel. Fuel additives such as *BioBor* and *Diesel Kleen* or *Cetane Boost* should be added at this time to control algae and condition the fuel. Care should be taken that the additives used are compatible with the primary fuel filter/water separator used in the system. Change the element in your primary fuel filter/water separator, if the fuel system has one, and clean the separator sediment bowl.

Change the fuel filter elements on the engine and bleed the fuel system, as needed. Start the engine and allow it to run for 5 – 10 minutes to make sure no air is left in the fuel system. Check for any leaks that may have been created in the fuel system during this servicing, correcting them as needed. Operating the engine for 5 – 10 minutes will help allow movement of the treated fuel through the injection equipment on the engine.

Raw Water Cooling Circuit

Close the through-hull seacock. Remove the raw water intake hose from the seacock. Place the end of this hose into a five gallon bucket of clean fresh water. Before starting the engine, check the zinc anode found in the primary heat exchanger on the engine and clean or replace it as required, and also clean any zinc debris from inside the heat exchanger where the zinc anode is located. Clean the raw water strainer.

Start the engine and allow the raw water pump to draw the fresh water through the system. When the bucket is empty, stop the engine and refill the bucket with an antifreeze solution slightly stronger than needed for winter freeze protection in your area.

Start the engine and allow all of this mixture to be drawn through the raw water system. Once the bucket is empty, stop the engine. This antifreeze mixture should protect the raw water circuit from freezing during the winter lay-up, as well as providing corrosion protection.

Remove the impeller from your raw water pump (some antifreeze mixture will accompany it, so catch it in a bucket). Examine the impeller. Acquire a replacement, if needed, and a cover gasket. Do not replace the impeller (into the pump) until recommissioning, but replace the cover and gasket.

Intake Manifold and Thru-Hull Exhaust

Place a clean cloth, lightly soaked in lubricating oil, in the opening of the intake manifold to block the opening. Do not shove the cloth out of sight. (If it is not visible at recommissioning, and an attempt is made to start the engine, you may need assistance of the servicing dealer. Make a note to remove the cloth prior to start-up. The thru-hull exhaust port can be blocked in the same manner.

Starter Motor

Lubrication and cleaning of the starter drive pinion is advisable, if access to the starter permits its easy removal. Make sure the battery connections are shut off before attempting to remove the starter. Take care in properly replacing any electrical connections removed from the starter.

Cylinder Lubrication *[Diesel]*

If you anticipate a long lay-up period (12 months or more) WESTERBEKE recommends removing the glow plugs for to access to the cylinders. Squirt light oil into the cylinders to prevent the piston rings from sticking to the cylinder walls. Turn the engine two revolutions by hand and then re-install the glow plugs.

Intake Manifold *[Gasoline]*

Clean the filter screen in the flame arrester, and place a clean cloth lightly soaked in lube oil around the flame arrester to block any opening. Also place an oil-soaked cloth in the through-hull exhaust port, Make a note to remove cloths prior to start-up!

Cylinder Lubrication *[Gasoline]*

Spray fogging oil into the open air intake, with the flame arrester removed, while the engine is running. The fogging oil will stall out the engine and coat the valves, cylinders and spark plugs for winter protection.

NOTE: *The spark plugs will need to be removed for cleaning and re-gapping at spring commissioning.*

Batteries

If batteries are to be left on board during the lay-up period, make sure that they are fully charged, and will remain that way, to prevent them from freezing. If there is any doubt that the batteries will not remain fully charged, or that they will be subjected to severe environmental conditions, remove the batteries and store them in a warmer, more compatible environment.

> ⚠ **WARNING:** ***Lead acid batteries emit hydrogen, a highly-explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.***

Transmission *[Propulsion Engine]*

Check or change the fluid in the transmission as required Wipe off grime and grease and touch up any unpainted areas. Protect the coupling and the output flange with an anti-corrosion coating. Check that the transmission vent is open. For additional information, refer to the *TRANSMISSION SECTION.*

Spare Parts

Lay-up time provides a good opportunity to inspect your Westerbeke engine to see if external items such as drive belts or coolant hoses need replacement. Check your basic spares kit and order items not on hand, or replace those items used during the lay-up, such as filters and zinc anodes. Refer to the *SPARE PARTS* section of this manual.

Recommissioning

The recommissioning of your Westerbeke engine after a seasonal lay-up generally follows the same procedures as those described in the *PREPARATIONS FOR STARTING* section regarding preparation for starting and normal starts. However, some of the lay-up procedures will need to be counteracted before starting the engine.

1. Remove the oil-soaked cloths from the intake manifold.
2. Remove the raw water pump cover and gasket and discard the old gasket. Install the raw water pump impeller removed during lay-up (or a replacement, if required). Install the raw water pump cover with a new cover gasket.
3. Reinstall the batteries that were removed during the lay-up, and reconnect the battery cables, making sure the terminals are clean and that the connections are tight. Check to make sure that the batteries are fully charged.

> ⚠ **CAUTION:** ***Wear rubber gloves, a rubber apron, and eye protection when servicing batteries. Lead acid batteries emit hydrogen, a highly explosive gas, which can be ignited by electrical arcing or a lighted cigarette, cigar, or pipe. Do not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the vicinity to prevent electrical arcing during servicing.***

4. Remove the spark plugs, wipe clean, re-gap, and install to proper tightness *[gasoline].*
5. Check the condition of the zinc anode in the raw water circuit and clean or replace the anode as needed. Note that it is not necessary to flush the antifreeze/fresh water solution from the raw water coolant system. When the engine is put into operation, the system will self-flush in a short period of time with no adverse affects. It is advisable, as either an end of season or recommissioning service, to inspect the area where the zinc is located in the heat exchanger and clear any and all zinc debris from that area.
6. Start the engine in accordance with procedures described in the *PREPARATIONS FOR STARTING* section of this manual.

STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

Inches (in) x 25.4 = Millimeters (mm) x .0394 = Inches
Feet (ft) x .305 = Meters (m) x 3.281 = Feet
Miles x 1.609 = Kilometers (km) x .0621 = Miles

DISTANCE EQUIVALENTS

1 Degree of Latitude = 60 Nm = 111.120 km
1 Minute of Latitude = 1 Nm = 1.862 km

VOLUME

Cubic Inches (in^3) x 16.387 = Cubic Centimeters x .061 = in^3
Imperial Pints (IMP pt) x .568 = Liters (L) x 1.76 = IMP pt
Imperial Quarts (IMP qt) x 1.137 = Liters (L) x.88 = IMP qt
Imperial Gallons (IMP gal) x 4.546 = Liters (L) x .22 = IMP gal
Imperial Quarts (IMP qt) x 1.201 = US Quarts (US qt) x .833 = IMP qt
Imperial Gallons (IMP gal) x 1.201 = US Gallons (US gal) x .833 = IMP gal
Fluid Ounces x 29.573 = Milliliters x .034 = Ounces
US Pints (US pt) x .473 = Liters(L) x 2.113 = Pints
US Quarts (US qt) x .946 = Liters (L) x 1.057 = Quarts
US Gallons (US gal) x 3.785 = Liters (L) x .264 = Gallons

MASS-WEIGHT

Ounces (oz) x 28.35 = Grams (g) x .035 = Ounces
Pounds (lb) x .454 = Kilograms (kg) x 2.205 = Pounds

PRESSURE

Pounds Per Sq In (psi) x 6.895 = Kilopascals (kPa) x .145 = psi
Inches of Mercury (Hg) x .4912 = psi x 2.036 = Hg
Inches of Mercury (Hg) x 3.377 = Kilopascals (kPa) x .2961 = Hg
Inches of Water (H_2O) x .07355 = Inches of Mercury x 13.783 = H_2O
Inches of Water (H_2O) x .03613 = psi x 27.684 = H_2O
Inches of Water (H_2O) x .248 = Kilopascals (kPa) x 4.026 = H_2O

TORQUE

Pounds-Force Inches (in-lb) x .113 = Newton Meters (Nm) x 8.85 =in-lb
Pounds-Force Feet (ft-lb) x 1.356 = Newton Meters (Nm) x .738 = ft-lb

VELOCITY

Miles Per Hour (MPH) x 1.609 = Kilometers Per Hour (KPH) x .621 = MPH

POWER

Horsepower (Hp) x .745 = Kilowatts (Kw) x 1.34 = MPH

FUEL CONSUMPTION

Miles Per Hour IMP (MPG) x .354 = Kilometers Per Liter (Km/L)
Kilometers Per Liter (Km/L) x 2.352 = IMP MPG
Miles Per Gallons US (MPG) x .425 = Kilometers Per Liter (Km/L)
Kilometers Per Liter (Km/L) x 2.352 = US MPG

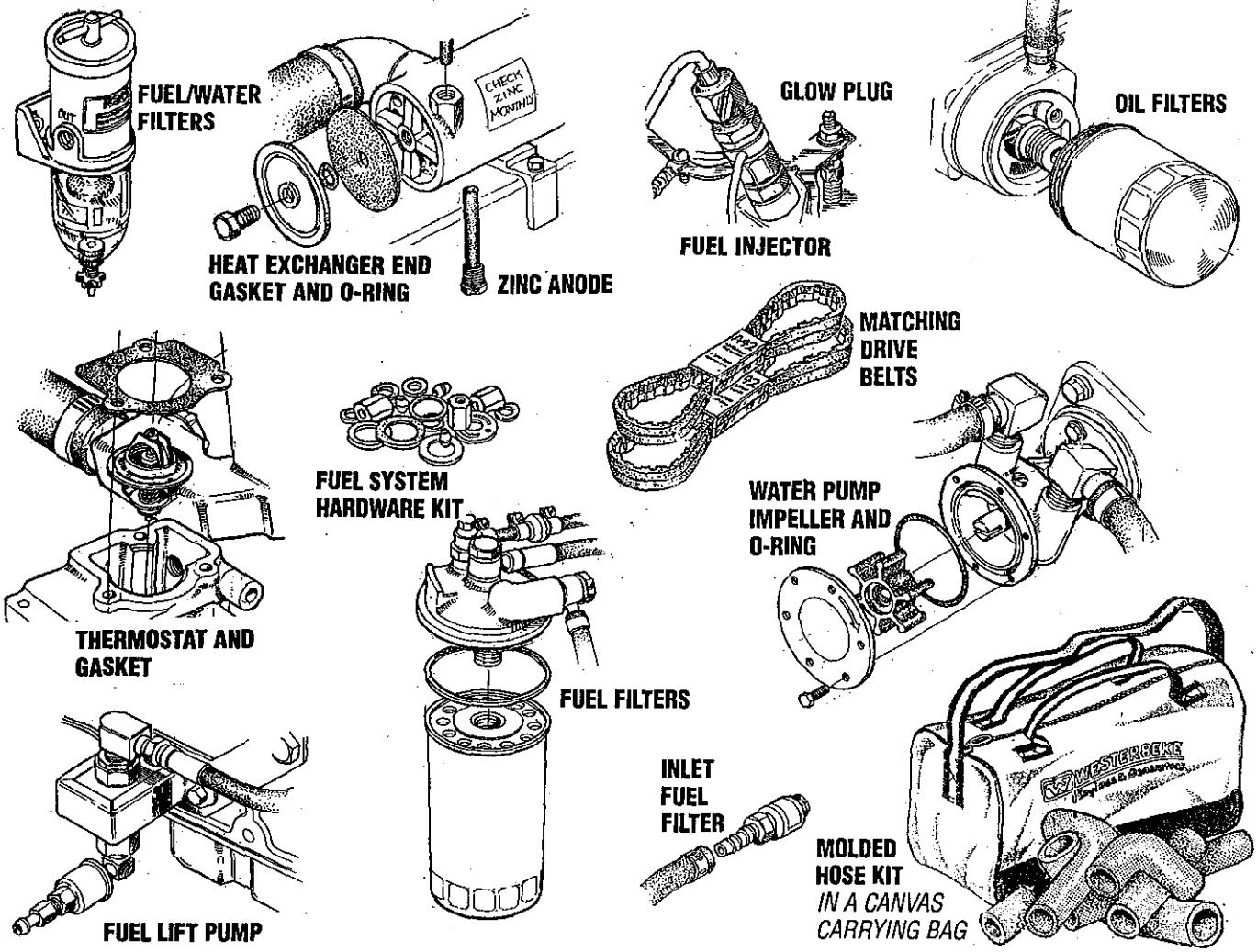
TEMPERATURE

Degree Fahrenheit (°F) = (°C X 1.8) + 32
Degree Celsius (°C) = (°F - 32) x .56

SUGGESTED SPARE PARTS

WESTERBEKE MARINE DIESEL GENERATORS

CONTACT YOUR WESTERBEKE DEALER FOR ADDITIONAL SUGGESTIONS AND INFORMATION

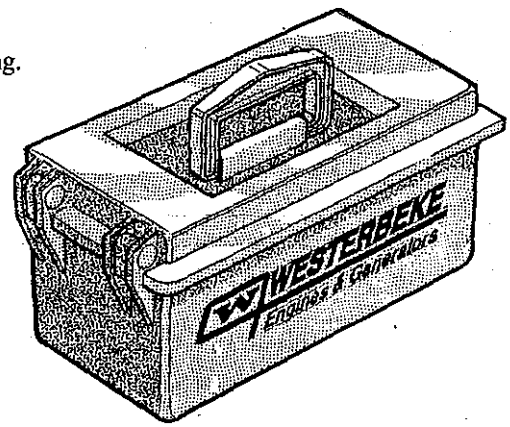


SPARE PARTS KITS

WESTERBEKE also offers two Spare Parts Kits, each packaged in a rugged hinged toolbox.
Kit "A" includes the basic spares.
Kit "B" is for more extensive off-shore cruising.

KIT A

- ZINC ANODES
- DRIVE BELTS
- OIL FILTER
- FUEL FILTER
- HEAT EXCHANGER GASKET
- IMPELLER KIT
- FUEL SYSTEM HARDWARE KIT
- FUEL PUMP INLET FILTER



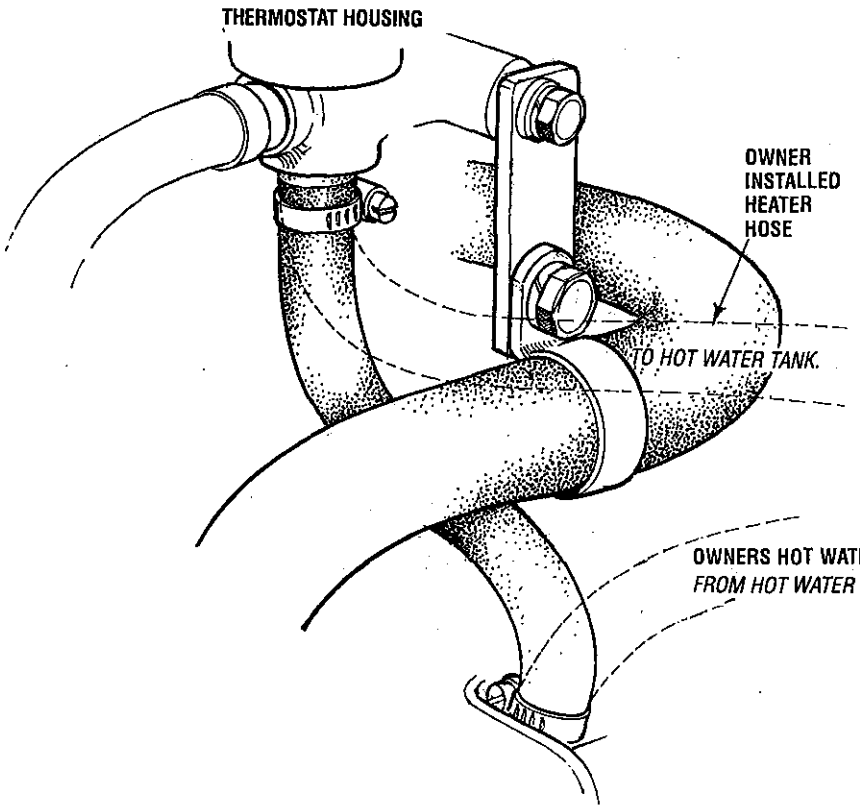
KIT B

- ZINC ANODES
- DRIVE BELTS
- OIL FILTER
- FUEL FILTER
- HEAT EXCHANGER GASKET
- IMPELLER KIT
- INJECTOR
- OVERHAUL GASKET KIT
- GLOW PLUG
- FUEL SYSTEM HARDWARE KIT
- FUEL PUMP INLET FILTER

WATER HEATER INSTALLATIONS

These engines are equipped with connections for the plumbing of engine coolant to transfer heat to an on-board water heater. The water heater should be mounted in a convenient location either in a high or low position in relation to the engine, so that the connecting hoses from the heater to the engine can run in a reasonably direct line without any loops which might trap air.

Hoses should rise continuously from their low point at the heater to the engine so that air will rise naturally from the heater to the engine. If trapped air is able to rise to the heater, then an air bleed petcock must be installed at the higher fitting on the heater for bleeding air while filling the system.

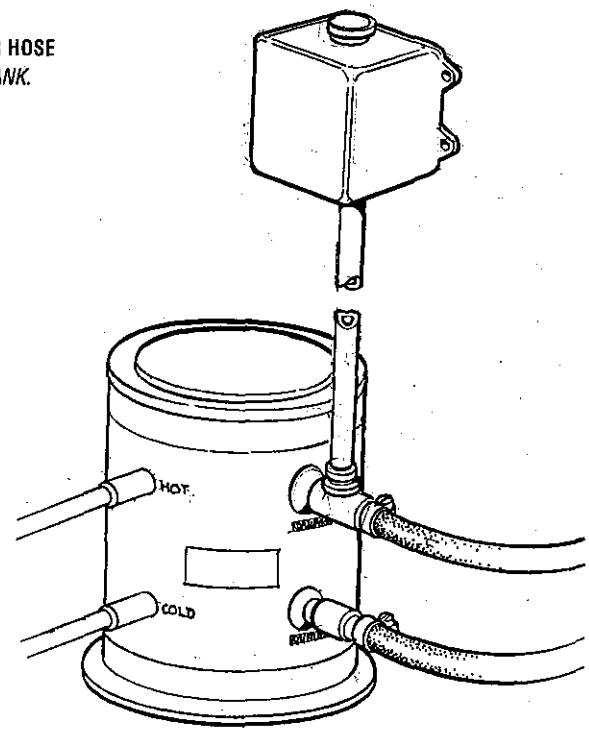


WATER HEATER CONNECTIONS

NOTE: *If any portion of the heating circuit rises above the engine's own pressure cap, then a pressurized (aluminum) remote expansion tank (Kit #024177)* ***must*** *be installed in the circuit to become the highest point. Tee the remote expansion tank into the heater circuit, choosing the higher of the two connections for the return. Tee at the heater, and plumb a single line up to the tanks location and the other back to the engine's return. Install the remote expansion tank in a convenient location so the coolant level can easily be checked. The remote expansion tank will now serve as a check and system fill point.* ***The plastic coolant recovery tank is not used when the remote expansion tank kit is installed, since this tank serves the same function.*** *Remove and store the plastic recovery tank if it has been already installed.*

The pressure cap on the engine's manifold should be installed after the engine's cooling system is filled with coolant. Finish filling the cooling system from the remote tank after the system is filled and is free of air and exhibits good coolant circulation. During engine operation, checking the engine's coolant should be done at the remote tank and not at the engine manifold cap. The hose connection from the heater to the remote expansion tank should be routed and supported so it rises continuously from the heater to the tank, enabling any air in the system to rise up to the tank and out of the system.

NOTE: *An air bleed petcock is located on the engine's heat exchanger. Open this petcock when filling the engine's coolant system to allow air in the exchanger to escape. Close tightly after all the air is removed.*



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Engines & Generators